BYTE

A McGRAW-HILL PUBLICATION

7 Tools to Turbocharge Your Database

Page 204



84 BYTE Award Winners, Plus International Picks

Best Products of 1991

Windows Accelerators Compared:
Graphics Boards from Actix, ATI, Artist Graphics, Orchid, STB, and BCC

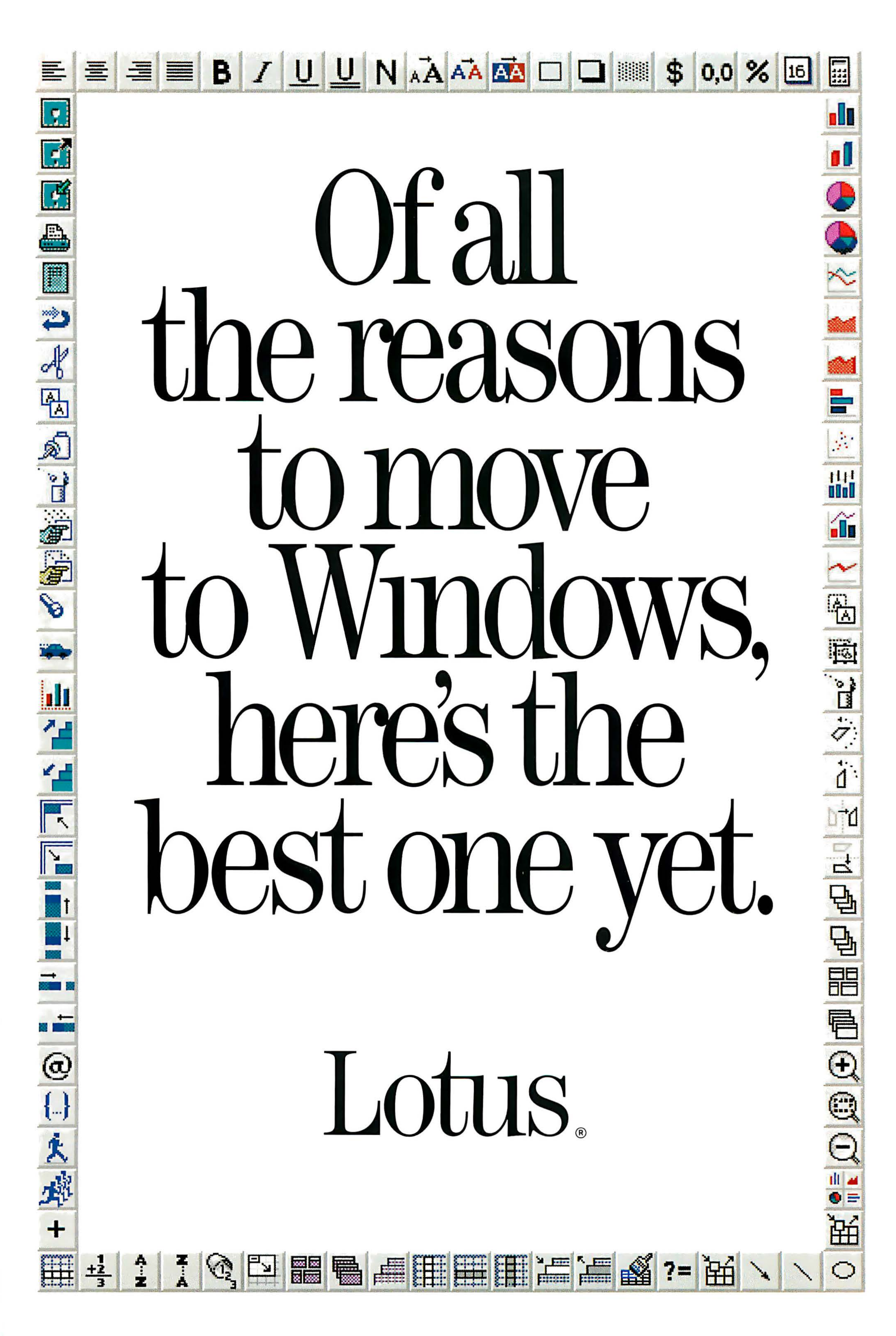
USER'S COLUMN
Jerry Pournelle on Windows 3.1

STATE OF THE ART
Developing Applications Across Platforms

PLUS
- 5 Statistics Packages
- The 8-oz. Psion Series 3 Palmtop
- ClarisWorks
- Microsoft Bookshelf for Windows 3.0
- Tektronix Phaser III Color Printer



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Of all
the reasons
to move
to Windows,
here's the
best one yet.
Lotus®



It's everything a Windows spreadsheet was meant to be.

After listening carefully to what our customers were looking for in a Windows™ spreadsheet, we developed Lotus® 1-2-3® for Windows with three goals in mind.

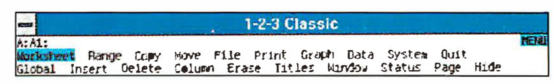
First, make it a full-fledged Windows application.

Second, introduce innovations that deliver a perfect balance of power and simplicity.

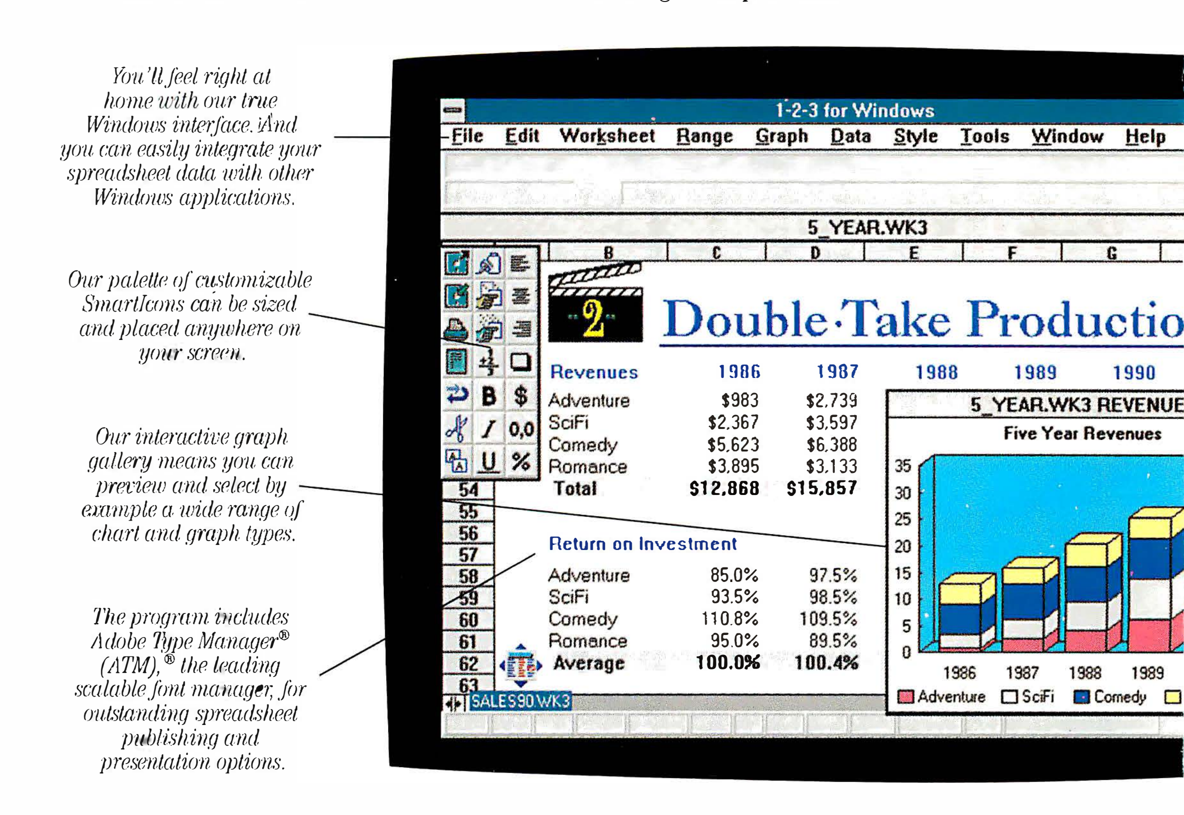
And third, make it fully compatible with all of the earlier versions of 1-2-3 that millions of 1-2-3 users are familiar with.

Well, we've done all this. And a whole lot more. Which, no doubt, is why 1-2-3 for Windows was awarded Byte Magazine's *Best New Windows Application* at Comdex/Spring '91.

For starters, the most exciting part of 1-2-3 for Windows is its SmartIcons,™ an innovative "one-click" approach for automating common spreadsheet tasks and fine tuning your working environment for even greater productivity. You'll also find these SmartIcons in all our Windows products, including Ami Pro™ 2.0, our award-winning word processor.



Push the slash key and you'll have instant access to the familiar 1-2-3 menu which will appear in a window on your screen.

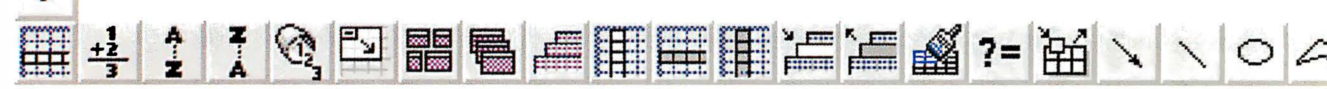


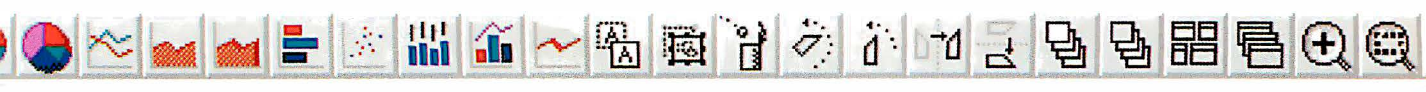
You'll feel right at home with our true Windows interface. And you can easily integrate your spreadsheet data with other Windows applications.

Our palette of customizable SmartIcons can be sized and placed anywhere on your screen.

Our interactive graph gallery means you can preview and select by example a wide range of chart and graph types.

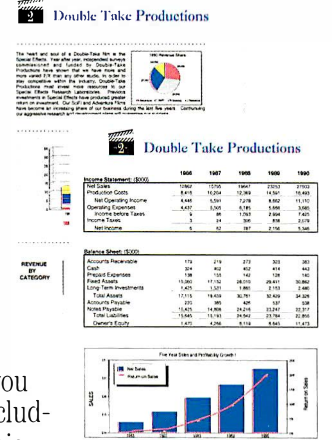
The program includes Adobe Type Manager® (ATM),® the leading scalable font manager, for outstanding spreadsheet publishing and presentation options.





...us 1-2-3 for Windows.

With our "zoom in," "zoom out" and fast print preview features, you can refine and perfect your work before you print. Which means your output will always be just what you want it to be. Without any surprises at the printer.



Unlike the Toolbar™ in Microsoft® Excel, 1-2-3 for Windows actually lets you create your own icons for the tasks that are unique to you.

And yes, 1-2-3 for Windows fully exploits the Windows environment. Which means it includes pull down menus, dialog boxes, sizable windows, mouse support, full DDE support and everything else you'd expect in a true Windows application.

What's more, with its interactive graph gallery, you can select by example a wide range of graph types, including true 3D graphs in bar, line, area, stacked bar and pie.

Of course, when you're ready to print, your results will be nothing short of perfection. And thanks to its Auto Compress feature, you can easily make an entire report fit on one page.

Beneath it all, you'll have the complete power of 1-2-3 at work for you. Including 3D worksheets, Solver goal-seeking features and external data access through DataLens.®

And finally, to make the move to Windows a simple one for 1-2-3 users, we've included the 1-2-3 Classic® commands in the program. Where, at the push of the slash key, the familiar 1-2-3 menu will appear, fully functional, on screen. So 1-2-3 for Windows offers you complete file, style, macro and keystroke compatibility with all of the previous versions of 1-2-3.

So see why Lotus 1-2-3 for Windows is more than a great Windows spreadsheet. It's everything you've been looking for in one.

And now, you can upgrade from your current version of 1-2-3 to 1-2-3 for Windows and get both 1-2-3 and Ami Pro 2.0 for just $199.* A suggested retail value of $645. For a free auto demo, or to order your upgrade directly from Lotus,** call **1-800-TRADEUP, ext. 6416.**

Lotus 1-2-3



These SmartIcons give you "one-click" shortcuts for your most frequently used tasks, such as opening and saving files and printing.

Use them for a variety of activities, from simple functions like auto-summing ranges to more powerful analytical tasks, such as accessing Solver.

SmartIcons give you easy access to Windows functionality like cutting, copying and pasting to and from the clipboard.

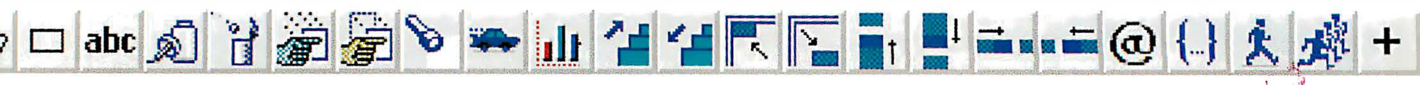
Virtually any formatting task you need to do, including pasting one cell's style to a range of cells, is just one click away.

SmartIcons make it incredibly easy to arrange your worksheets in three different views: tile, cascading and 3D perspective.

Click this and you'll create charts and graphs automatically. Then the icon palette will change to provide SmartIcons that enhance your graphs.

Run and de-bug macros, select macro keywords, or create your own customized icons for your macros.

1-2-3 for Windows Lotus



Revenues	1986
Adventure	$983
SciFi	$2,367
Comed	$5,623
Roman	$3,895
Total	**12,868**

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Advent	85.0%
SciFi	93.5%
Comed	110.8%
Romance	95.0%
Average	**100.0%**

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January 1992 *Volume 17, Number 1*

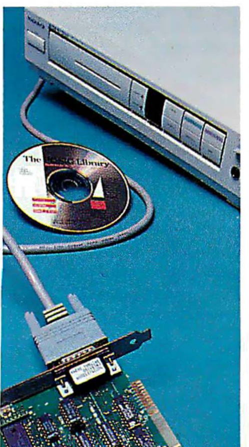


COVER STORY

The 1991 BYTE Awards

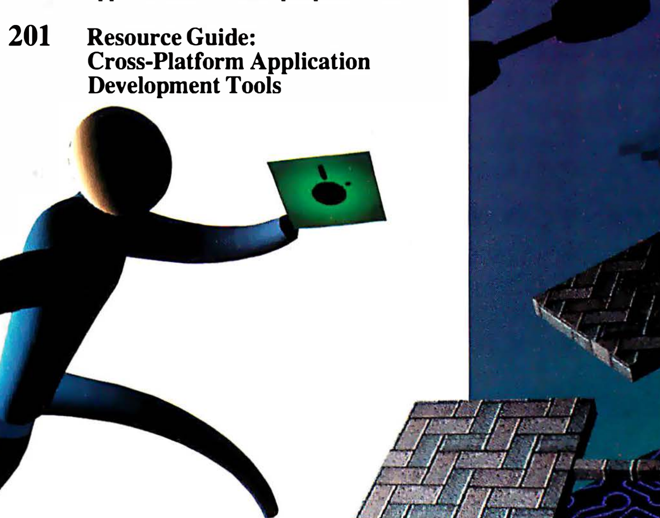
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INSIDE BYTE

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REGIONAL SECTION begins after page 86

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BYTE Topic Index and Author Guide

This index helps you find articles that contain information on each of the listed topics. (The topic list changes each month.) Combined with the table of contents (page 4) and the Editorial Index by Company (page 402), you can identify articles by type, subject, title, author, or product discussed.

Panasonic announces another breakthrough in non-interlaced 1,024 x 768 graphics.

Value.

If you thought you'd have to compromise on your next High Resolution monitor, think again. With its new 14" PanaSync™ C1395, Panasonic® brings all the compelling clarity and richness of non-interlaced graphics within reach.

Turn it on, and you'll see your most graphics-intensive applications in a whole new light. Compared to interlaced monitors, images will be sharper, edges cleaner, details finer. With noticeably less flicker. Because now you're getting the whole picture, not just every other line. And the C1395 is as easy on your eyes as it is on your wallet.

Like all Panasonic monitors, the C1395 has excellent ergonomics. Controls are front-mounted, and a tilt-swivel stand is included.

So, whether your desktop is MS-DOS, a MAC II* or one of the other leading workstations, before you spend several hundred dollars more on a new monitor, spend a few minutes at your authorized Panasonic dealer. He'll show you that value has never looked so good.

For further information on the PanaSync C1395 Multi-Frequency Monitor, telephone 1-800-742-8086.

Monitors, Computers, Peripherals, Printers, Copiers, Typewriters & Facsimiles



Engineered for the office. Designed for people.

*MAC II is a registered trademark of Apple Computer, Inc. An optional cable is required for Macintosh, the C81M2.

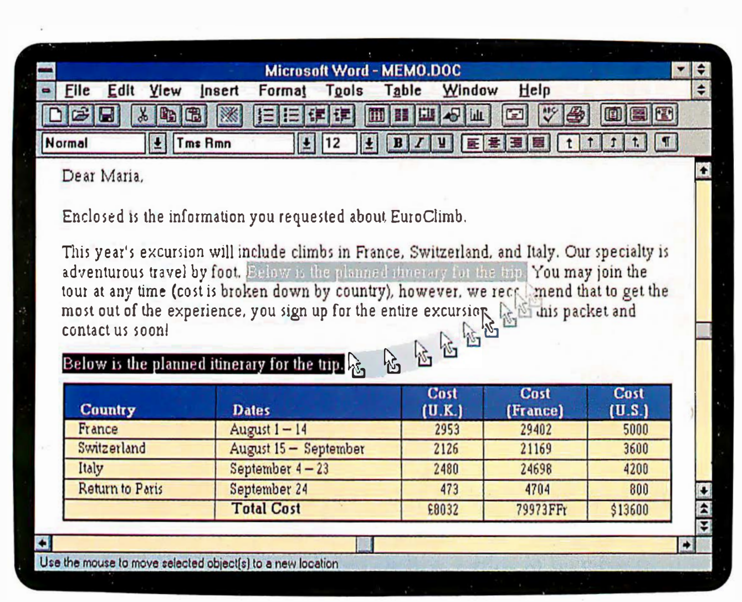
M4-BY

Circle 120 on Inquiry Card.

The first wo that works like



The Toolbar lets you do everyday things with the click of a button.

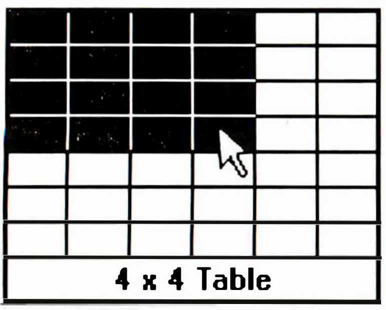


Country	Dates	Cost (U.K.)	Cost (France)	Cost (U.S.)
France	August 1 – 14	2953	29402	5000
Switzerland	August 15 – September	2126	21169	3600
Italy	September 4 – 23	2480	24698	4200
Return to Paris	September 24	473	4704	800
	Total Cost	£8032	79973FFr	$13600

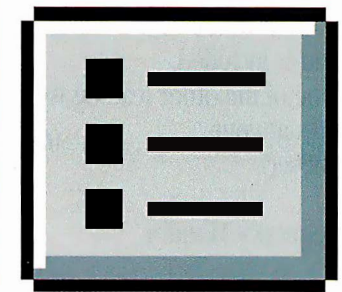
Rearranging a document couldn't be any easier. With new Word 2.0 you can drag and drop text wherever you want.



The mouse makes everyday tasks as easy as click, click, click.

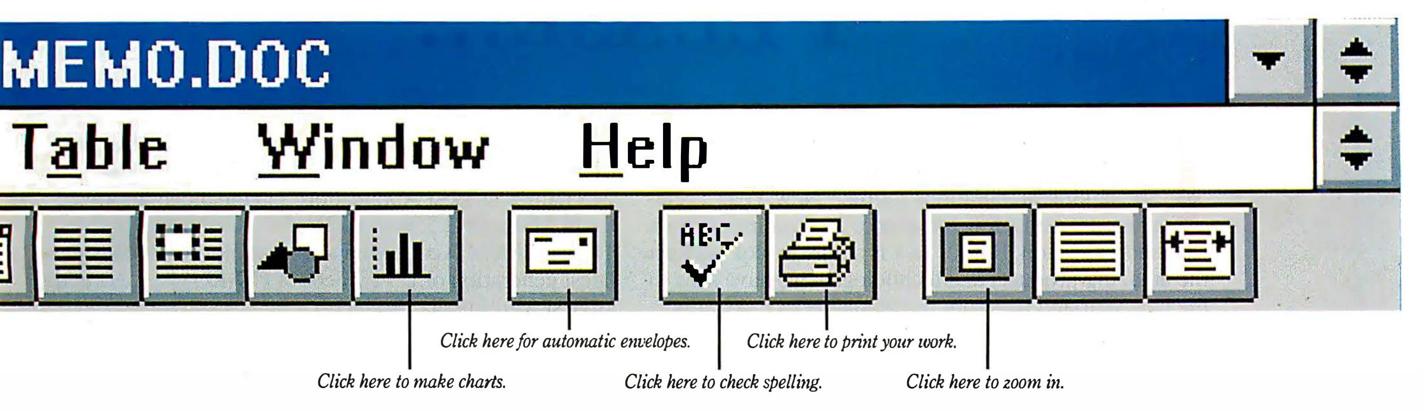


All it takes is one click on the Toolbar and presto, instant tables.

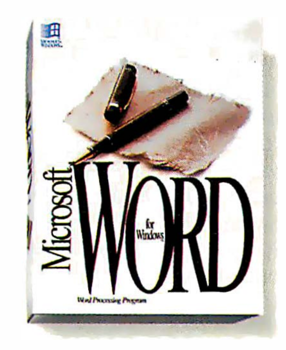


Click this Toolbar button and get instant bullets.

rd processor second nature.



Introducing new Word for Windows 2.0.



When it comes to word processing, really nothing could be more natural than using the all-new Microsoft® Word for Windows.™ You see, Word 2.0 makes those everyday word processing tasks remarkably easy.

Which means you can now concentrate on what you're actually doing. Rather than how you're actually going to do it.

This is possible for a number of reasons. Like our unique Toolbar™ feature. It lets you do those things you do most often with one simple click of a button.

Of course, looks count for something, too. With Word you can bring in a table of numbers from Microsoft Excel. Or with the new built-in drawing, charting and shading features, along with the ability to move anything on-screen with a drag and drop, you'll find yourself adding some very very cool effects.

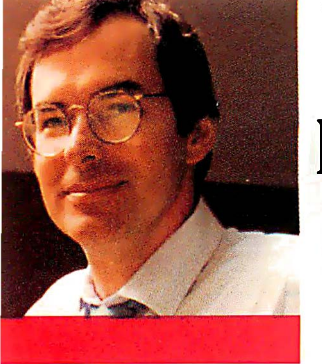
But best of all, making the move is easy–so easy there is virtually no downtime. Just type in a WordPerfect® keystroke and Word demonstrates the equivalent command right in your document. Plus, your existing WordPerfect files (and other file formats) are perfectly usable in Word.

You can get all of this and a lot more when you upgrade to Word for Windows for only $129.* So pick up the phone and call us at (800) 323-3577, Department W3.

You'll quickly see that nothing could be more natural.

Microsoft®

*Offer good for current licensees of WordPerfect, MultiMate, WordStar, MS Word for DOS and DisplayWrite. Please allow 2-4 weeks for delivery upon receipt of order by Microsoft. Offer expires 3/31/92. Limit one per customer. Reseller prices may vary. Call for system requirements. Offer good only in the 50 United States. In the United States, call (800) 323-3577, Dept. W3. For information only: In Canada, call (800) 563-9048; outside the United States and Canada, call (206) 936-8661. Microsoft is a registered trademark and Toolbar and Windows are trademarks of Microsoft Corporation. WordPerfect is a registered trademark of the WordPerfect Corporation.



EDITORIAL

RICH MALLOY

THE ENVELOPE, PLEASE...

It's that time of year again. Many people are rushing around doing last-minute Christmas shopping. Some are making preparations for their New Year's celebrations. And a few lucky ones are heading off for a short vacation. But for us it is a time to look back on the amazing products and technologies we have seen in the past year and hand out our annual BYTE Awards.

BYTE's Best of Comdex Awards honor products that are announced at the show

In the past 12 months, we have mentioned roughly 2000 computer products in these pages—by our calculations, more than any other computer magazine around. All the products seemed good, or we wouldn't have spent time on them. Most were very impressive indeed. And some were so impressive that they are worthy of special consideration.

One of the most satisfying aspects of working at BYTE is having the chance to see these products. But even more satisfying is having the chance to disseminate the results of our findings to our readers. With our awards, we are able to give added prominence to those products that clearly deserve it. This process of giving out awards is a heady responsibility, but a gratifying one as well.

Actually, our award season—like the Christmas holiday season—started several weeks ago. At the recent Comdex, we officially kicked off the season by once again giving out awards for the best new products at the show. These Best of Comdex Awards are also known as the Shelly Awards, in honor of the man who created Comdex, Sheldon G. Adelson.

The Shelly Awards focus on the future, on brand-new products that may not be shipping for some time to come. They are our way of previewing the big new products of next year. We look for products or technologies that are innovative, that have had a strong impact on Comdex attendees, and that should have a strong impact on business computer use worldwide. As you can imagine, there was no shortage of products to examine.

Sniffing out the best new products at a show that has 2000 exhibitors is no easy feat. We flew in a team of 25 editors, divided up the show floor, and set them loose. The editors spent a great amount of time on this, braving traffic jams, huge taxi lines, and Las Vegas fast food. But the results were worth it.

We gave out awards in eight categories. Some were no surprise to anyone at the show; all you had to do was look for the largest crowds. The Apple Mac PowerBook 170 notebook was selected as Best Portable. We gave Microsoft two awards: The new Word for Windows 2.0 was named as Best Application, and the much improved LAN Manager 2.1 won as Best Connectivity Product. The Intel/IBM ActionMedia II technology, which is the latest generation of DVI video for CD-ROMs, was cited as Best Multimedia Product.

But the best thing about giving out awards is the chance to honor deserving products that might not have the benefit of a huge promotional budget. We awarded DR DOS 6.0 from Digital Research the prize for Best Utility Software. The Best Peripheral award was snared by JVC for its innovative Personal ROMMaker, the first moderately priced device for producing CD-ROMs. Texas Microsystems won the Best Desktop award for its FTSA PC, a fault-tolerant PC that will surely influence other system manufacturers. The British company Psion won top honors in the Best International Product category for its Psion Series 3 palmtop system. In fact, at the awards ceremony, Psion officials almost sold three of its innovative palmtop systems to the other prize winners.

The most dramatic award was the Best of Show, but there was not much question about who should receive this. We gave this award to Intel and IBM for the ActionMedia II technology, which will probably have an impact on every system manufacturer in one way or another.

The Best of 1991

While Comdex gave us a chance to look at what might be the best products of next year, the closing days of 1991 remind us that we cannot avoid mentioning the best products of this past year. For these products, we have our BYTE Awards of Excellence, Distinction, and Merit, which are the subject of the cover story in this issue.

If picking the best products at a show like Comdex was difficult, picking the best products of an entire year is several times more so. Fellow Executive Editor Michael Nadeau probably deserves an award of his own for helping us sort through the hundreds of products we have examined in the past year.

To the products that have won awards, we raise a year-end toast of congratulations. But we also toast all the products that have come our way and that have made 1991 so interesting and enjoyable.

And now, for the winners of 1991, the envelope, please....

—Rich Malloy
Executive Editor
(BIX name "rmalloy")

Why your next should be a

By now, you're probably aware that an Apple® Macintosh® personal computer was designed from the very first chip to work the same, intuitive way that you do.

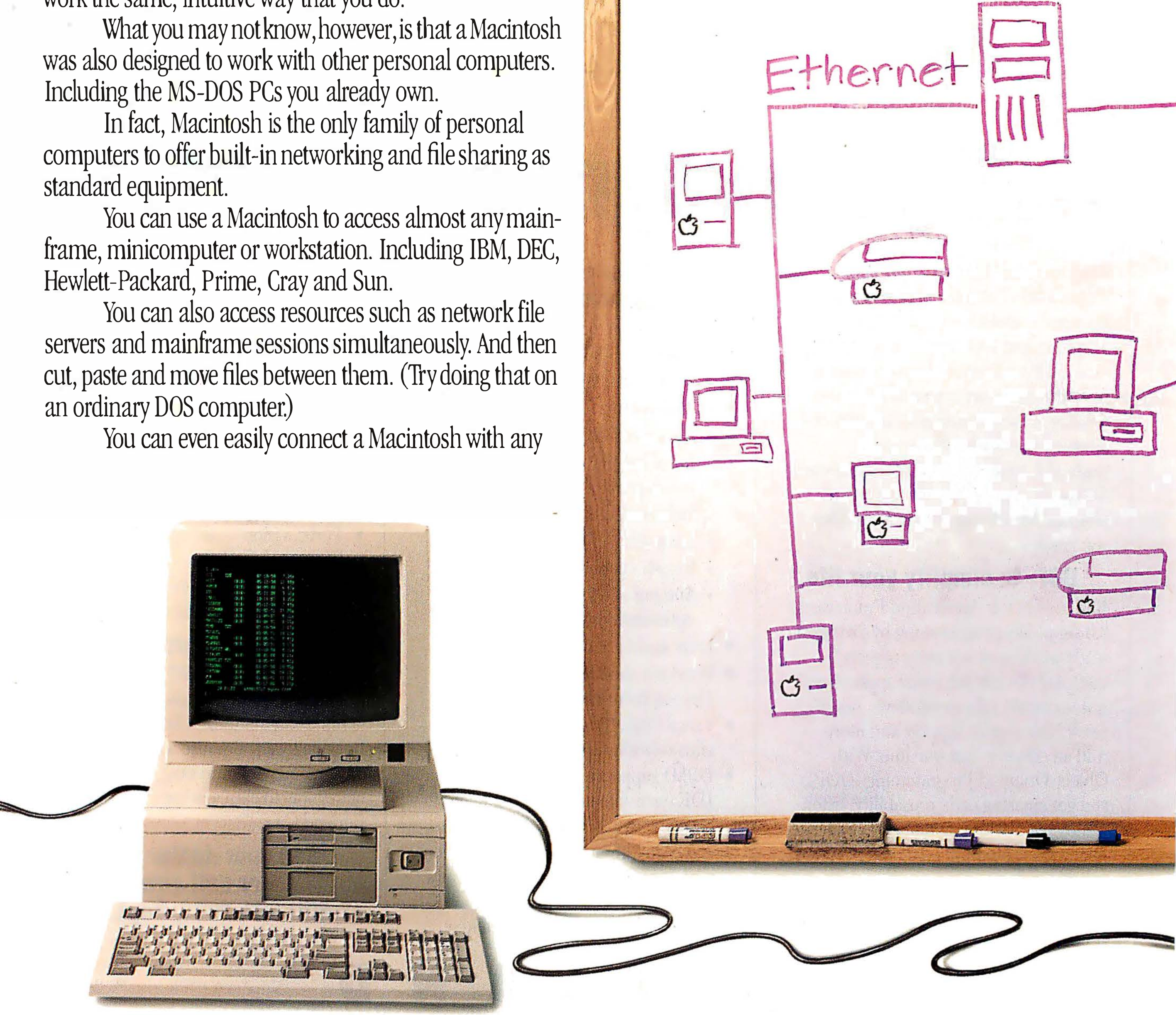
What you may not know, however, is that a Macintosh was also designed to work with other personal computers. Including the MS-DOS PCs you already own.

In fact, Macintosh is the only family of personal computers to offer built-in networking and file sharing as standard equipment.

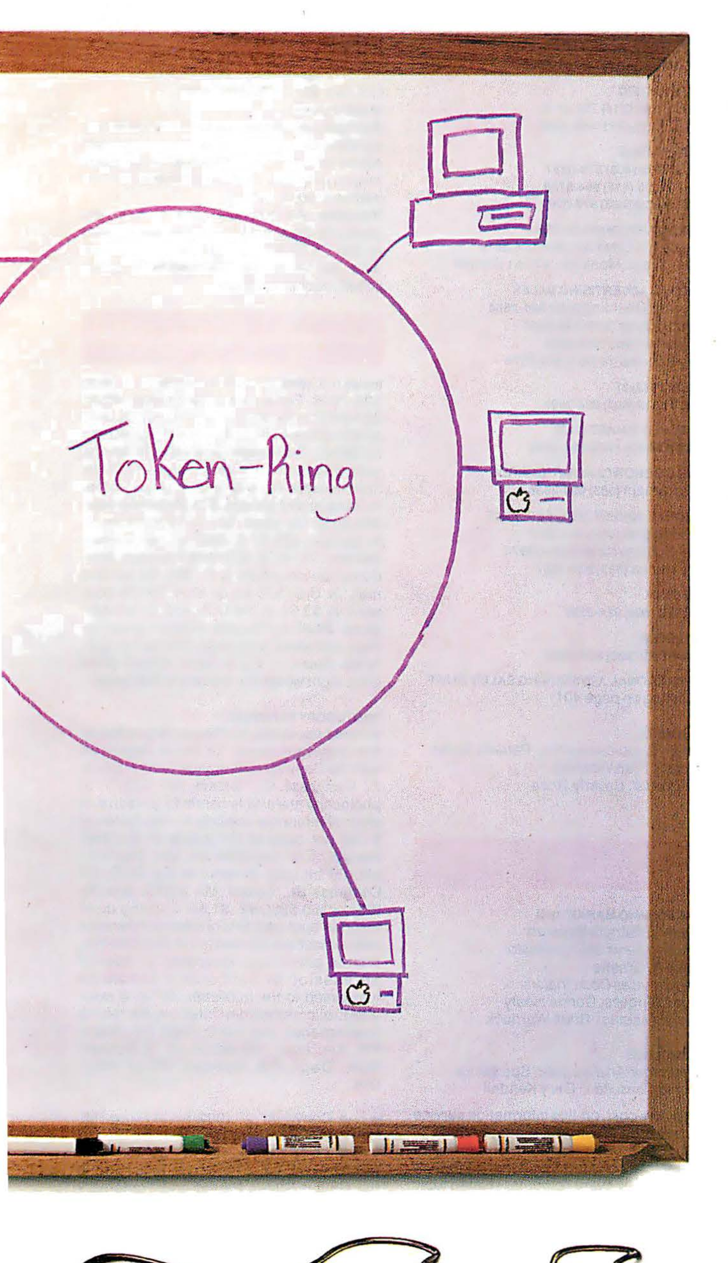
You can use a Macintosh to access almost any mainframe, minicomputer or workstation. Including IBM, DEC, Hewlett-Packard, Prime, Cray and Sun.

You can also access resources such as network file servers and mainframe sessions simultaneously. And then cut, paste and move files between them. (Try doing that on an ordinary DOS computer.)

You can even easily connect a Macintosh with any



DOS computer Macintosh.



industry-standard Token-Ring or Ethernet network. And share files and printers over Novell NetWare, Banyan VINES, IBM LAN Server or Microsoft LAN Manager networks.

Best of all, only Macintosh offers a single, consistent, intuitive way of accessing and working with information, no matter what computer it's located on.

And, of course, Macintosh also has the power to run MS-DOS software,* and lets you exchange information with a PC on a standard 3 ½" floppy disk.

Today's family of affordable Macintosh computers offers you more choices and more flexibility than any other personal computer. So your people can work in whatever way works best for them, while you preserve your investment in the networks and PCs you already own.

For the name of the authorized Apple reseller near you, call 800-538-9696, ext. 330. You'll find that Macintosh has the power you can really connect with. The power to be your best.®



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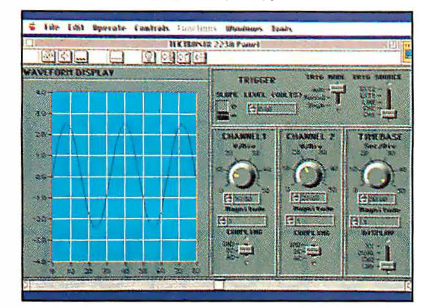


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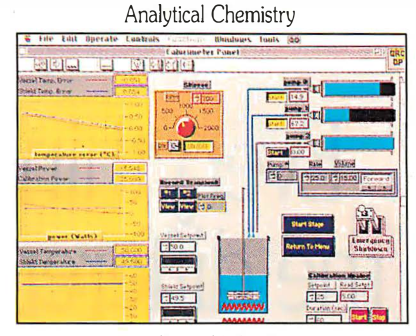


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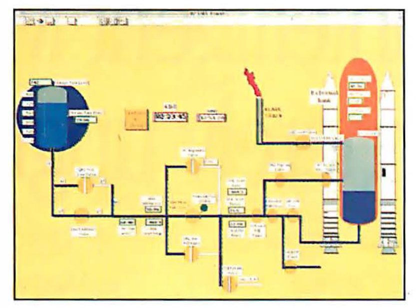
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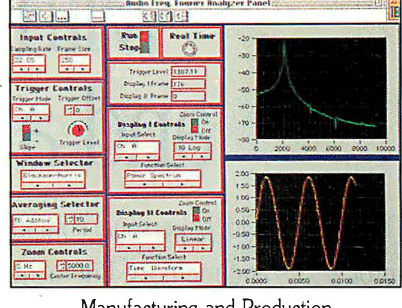
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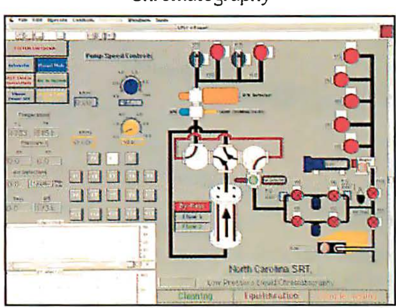
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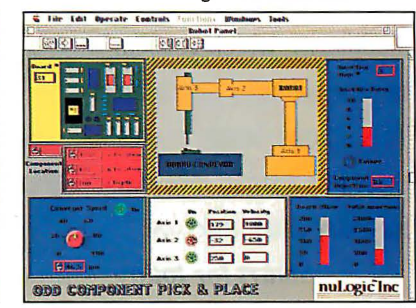
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3. Separate I/O board for potential enhancements and ease of service	Yes	No	No	No	No
4. 14 levels of security including cable-lock provision	Yes	No	No	No	No
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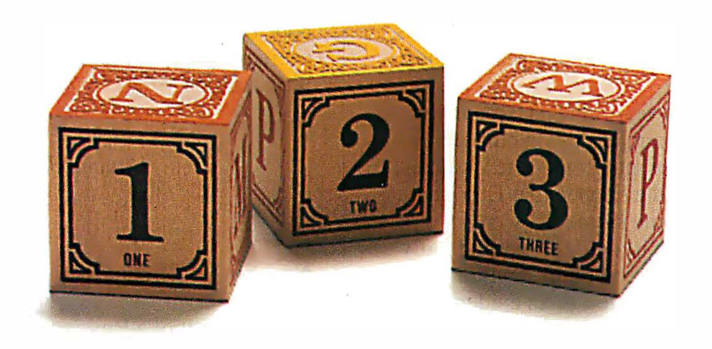
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LETTERS

Monitor Dangers?

While useful in most respects, David A. Harvey's "Health and Safety First" (October 1991) exhibited some muddled thinking about extremely low frequency (ELF) and very low frequency (VLF) emissions from computer monitors. He first says that "it wasn't until recently that hard data began rolling in on the subject." Two paragraphs later, he states that "there is a frustrating absence of hard data."


FEATURE

Health and Safety First

Indeed, it is precisely the absence of hard data about alleged VDT dangers, along with the lack of any theoretical model of how ELF/VLF fields could be harmful, that has led most scientists to conclude that the dangers are small to nonexistent. This has left the VDT debate largely in the hands of fast-buck artists who make a fortune by scaring the daylights out of people.

Most studies have found no verifiable hazards in the magnetic fields or in non-ionizing radiation emitted by properly functioning computer monitors. A few studies, however, have found statistical evidence that ELF and VLF emissions might pose some small risks.

With over 30 million people in the U.S. getting daily exposure to ELF/VLF-emitting computer monitors, any significant danger would be reflected in an epidemic of VDT-related illnesses. An epidemic has not materialized, which suggests that—at least in the short run—VDT risks are small.

The ELF/VLF radiation issue does need to be studied further. However, BYTE would serve its readers better by presenting a well-researched discussion of the problem.

Scott D. Palmer
Indianapolis, IN

Please see "Of Monitors and Emissions" (September 1990) for an in-depth discussion of this issue.—Eds.

CD-ROM Niche

I am writing in response to "CD-ROM Drives: How Good Is the Third Generation?" by David A. Harvey (September 1991). Hitachi is pleased with the excellent review of its CDR-1750S drive. However, we would like to address Harvey's recommendations against the CDR-1700S based on its performance when playing back animated sequences and its use of a non-SCSI drive adapter to Hitachi's PC or Micro Channel bus interface cards.

Most CD-ROM applications are text-based, with limited use of still graphics and audio. Few CD-ROM applications for DOS computers use animation throughout the application, and even the National Geographic Mammals disc has limited animation sequences. Uneven motion during animation with the CDR-1700S is designed to meet hardware and software compatibility requirements of our installed base, which demands upwardly compatible hardware. Hitachi offers both drive types to meet customer demands. The CDR-1700S performance on applications is competitive with other non-SCSI-bus drives and to the drives in your review.

We hold BYTE in the highest regard and acknowledge the influence it has on the personal computer market. We hope that potential CD-ROM drive customers will not overemphasize animation when text is of primary importance.

Eric Kamayatsu
Multimedia Systems
Hitachi Home Electronics (America), Inc.
Compton, CA

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Your letter will be read, but because of the large volume of mail we receive, we cannot guarantee publication. We also reserve the right to edit letters. It takes about four months from the time we receive a letter until we publish it.

New Soviet Threat?

The threat of a Russian nuclear attack may now be lessened, but some unexpected things may await the U.S. on another battlefront: the computer software market. Soon we may see real competition between Russians and Americans in software development.

Soviet programming potential is like boiling intellect developing inside a rubber balloon. As development advances, the balloon's size increases and pressure rises until the cover bursts (such a moment is not far away). Surely, Russians have a lot to learn from Americans about software creation. But there's no question that Soviet programmers are demonstrating originality in their work. The main areas where Soviets could establish competitive positions are scientific and system software.

I do hope the world software market will be the only battlefield for American and Soviet programmers and that we'll become friends during this new battle now that we've stopped wasting our intellects on the senseless weapons race.

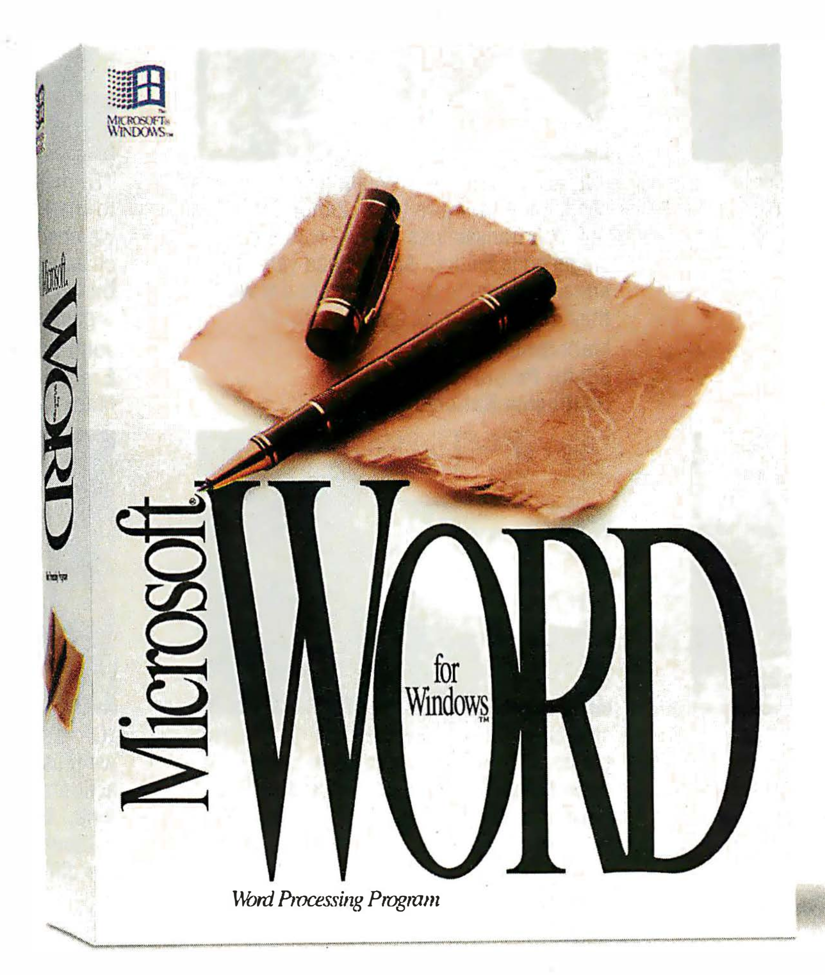
Alexander Beresne
U.S.S.R.

More on COBOL

I enjoyed Doris Appleby's article on COBOL ("Classic Languages, Part 2," October 1991), but I must take issue with one comment she makes about recursion: "COBOL does not support recursion, nor is it likely to in the future."

Although it's true that the CODASYL standard does not support recursion, Micro Focus lifted this restriction in the most recent release of COBOL/2. This was done to add features to the language for event-driven programming, specifically in the Windows and Presentation

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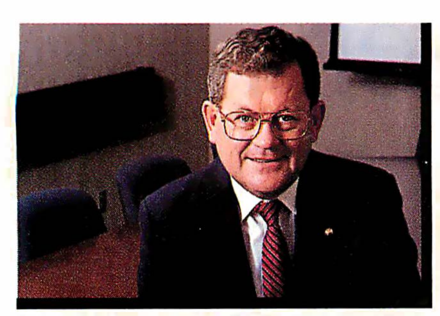
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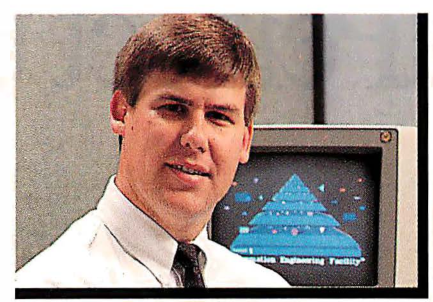
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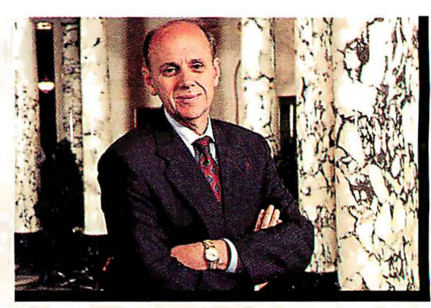
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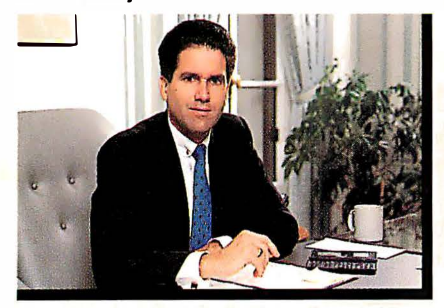
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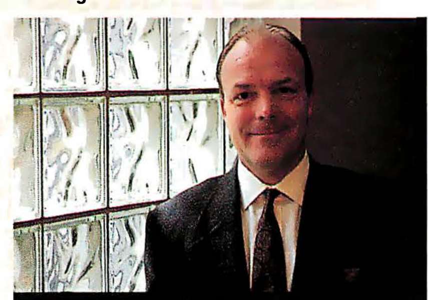
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"The strengths of the IEF are clear-cut. One obvious quality advantage is that application changes are made to diagrams, not code. This ensures ongoing integrity —the specification always matches the executing system."

Paul R. Hessinger
Chief Technology Officer
Computer Task Group



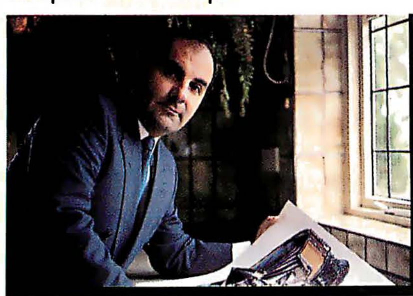
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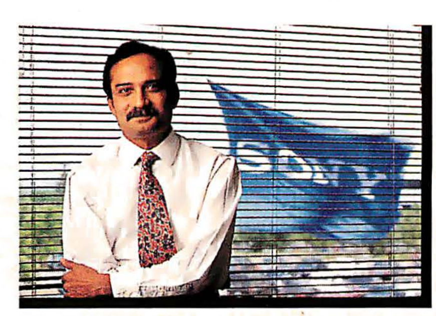
"Our users were extremely pleased when we finished our first project—a 60-transaction system—in one-half the budgeted time. We had tried interfaced CASE tools without success. IEF integration makes the difference."

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Division Head – MIS
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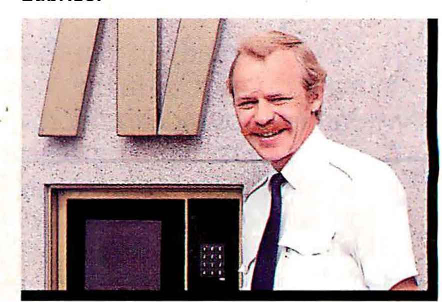
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Wal Budzynski
Head of Operations, Systems/Computing
Rolls-Royce



"The IEF offers dramatic improvements in productivity, yet it's easy to learn. One example: We trained 23 developers, including 18 new hires, and then completed a large order processing system—300 transactions—all in only 20 months."

Venkat (Vinnie) Tiruviluamala
Director, CPC/CPPC Information Systems
SONY Corporation



"Our first IEF system was completed faster, and with fewer errors, than any system I've ever seen. If I had to go back to the old ways, I'd find another job...outside the DP world. It means that much to me."

Mogens Sorensen
Chief Consultant
Nykredit (Denmark)

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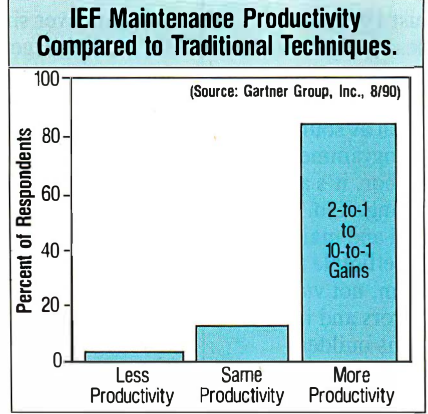
The quality of IEF-developed systems is remarkable. In recent CASE research by The Gartner Group, application developers were asked to report the number of abends they had experienced. (An "abend" is a system failure or "lock-up" caused by code defects.) *IEF developers reported zero defects—not one abend had occurred in IEF-generated code.*

Maintenance productivity gains of up to 10-to-1.

In this same study, developers were asked to compare IEF maintenance productivity with their former methods. Of those responding, *more than 80 percent had experienced gains of from 2-to-1 to 10-to-1.* (See chart.)

Specifications always match the executing application.

With the IEF, application changes are made to diagrams, not code. So, for the life of your system, specifications will always match the executing application. The Gartner Group research showed that *all* IEF users who reported making application changes made *all* changes at the diagram level.



Developers were asked to compare IEF maintenance to former methods. Of those responding, more than 80% reported productivity gains of from 2-to-1 to 10-to-1.

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The IEF has generated applications for IBM mainframe environments (MVS/DB2 under TSO, IMS/DC, and CICS) since early 1988. Soon you'll be able to develop systems in OS/2 and then automatically generate for other platforms. DEC/VMS, TANDEM and UNIX are scheduled for availability in 1991. More will follow. We are committed to increased environmental independence in support of the Open Systems concept.

We are committed to standards.

IEF tools and IEF-generated code will comply with standards as they emerge. We will adhere to CUA standards and to the principles of IBM's AD/Cycle and DEC's COHESION—and we will support Open Systems environments centering around UNIX. In any environment, the COBOL, C and SQL we generate adhere closely to ANSI standards. Our presence on standards committees helps us keep abreast of ANSI and ISO developments affecting the CASE world.

Full-service support.

Of course, our technical support, consultancy, training courses, satellite seminars, and other informational assistance will continue apace. We also offer re-engineering and template services. This full-service support will remain an integral part of the IEF product.

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Or write Texas Instruments, 6550 Chase Oaks Blvd., Plano, Texas 75023.



Manager environments.

Programmers find COBOL cumbersome and overly verbose, but it has the advantage of being easier to manage by virtue of readability. This, along with the sheer volume of code currently in production and development in the CASE industry, will guarantee its longevity well into the next century.

Jeffrey Harker
Northridge, CA

Shorthand Warning

In "The Hungarian Revolution" (August 1991) Charles Simonyi and Martin Heller describe yet another shorthand system. As with all such systems, the writer has a distinct short-term advantage. Shorthand may be useful for working documents, such as source code, currently being manipulated by a programmer. However, when read later, even by the author, it's all so much gobbledygook—not even close to Hungarian.

Building systems that can be understood and maintained by others requires coding that is intelligible to people. Let the machines adapt to our norm, not vice versa. Compilers can detect type usage errors and inform the error prone. I'm well aware that systems builders swear that they will document those obfuscated lines of code, but mostly they don't—at least not very well. Source code can be represented as the reality to which the documentation becomes a map. Where they are incongruous, your point is lost.

Writing source code in shorthand is acceptable. It is not acceptable to keep it in that form when future uses are taken into account. We in the computer world have long resorted to various shorthand strategies because of machine limitations. Now that the machines are approaching an understanding of our natural language, let's not lose it. Translate to some commonly recognizable subset of the national tongue, please.

Roger L. Boese
Seoul, Korea

C Notes

From time to time, Jerry Pournelle blames C for the troubles in projects. I don't think the language itself is entirely to blame: It seems that C's reputation for being messy attracts messy programmers. I just taught a guy the first things about C. He knew BASIC and Pascal, but he thought that they were much too difficult to use: all those PEEKs and POKEs you had to do. But then he heard about C being well suited for writing messy, bit-twiddling stuff, and he just loved the thought of it.

The point is, he would write just as messy code in Turbo Pascal. Up to now I've done most of my programming in C, and I have a pretty good idea why some people dismiss BASIC as a language for real programming. I just have to look at my C programs: They're well designed, well structured, well commented, and readable. When I glance at one of my old BASIC programs, I see good old spaghetti-style code.

Anders Munch
Copenhagen, Denmark

I agree that you can write good programs or bad programs in any language. Some, though, encourage good habits, and some do not. —Jerry Pournelle

Having enjoyed Jerry Pournelle's column for many years, I'm sorry that this letter was inspired because my feelings were hurt by something he wrote. I'm referring to his remark that "C is the last attempt of the high priesthood to control the computing business. It's like the scribes and the Pharisees who did not want the masses to learn how to read and write."

Although I am a linguist by profession, I've liked to program ever since I first learned FORTRAN in 1969. Of the languages I know well (FORTRAN, Pascal, Prolog, and C), as well as the languages I know a bit about (Lisp, COBOL, BASIC, and Modula-2), C is the one I like best. And I think that this is probably a major factor in the popularity of C—programmers like it.

One can speculate about why this is so. For me, first of all, C is not cloying. I also find that it is convenient in countless ways: its handy abbreviatory operators, its flatness, and the fact that C code is much easier to read than code in true block-structured languages (an important factor if you are working with someone else's code).

As I'm sure you know, virtually any program written in Pascal receives a 20 percent boost in efficiency when ported to C. A major reason why this is so is that it is easy to use pointers for array manipulations in C and memory is more efficiently accessed and used.

In any event, what hurt me was Jerry's comparison of programmers to some high priesthood. In the first place, programmers are not very high on any company's ladder. I doubt that anyone decides to go into programming because the position of programmer allows one to yield a lot of power. I also doubt that money is any kind of incentive—programmers' salaries are not very high. Finally, I have never met a programmer who was not delighted to explain the details of his or her craft to the uninitiated.

I'm sure that most programmers would agree that programming is healthy for the mind and that, at least in small amounts, it would probably benefit everyone in our society to know how to program. Isn't that the opposite of the attitude of the ancient scribes?

Chet Creider
University of Western Ontario
London, Ontario, Canada

I know that C programmers like C. Alas, few C programmers like real programs that any other C programmer wrote; hence, in recorded history there are probably only about four cases in which a large C program done by one programmer has been maintained by another C programmer without extensive rewriting and revision.

Meanwhile, it's still the case in the world I live in that whenever I hear of a program that has a known but unfixable bug, the chances are very large that it was written in C.

I'm sure C is wonderful, and I've always said it might well be the language of choice for full-time professionals (although it wouldn't be mine), but my goal is to get every PC owner to do some programming—and that isn't going to happen if they have to learn C first.
—Jerry Pournelle ■

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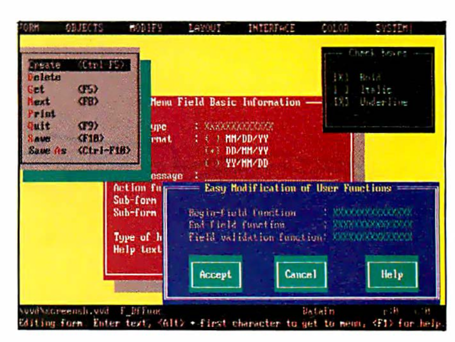
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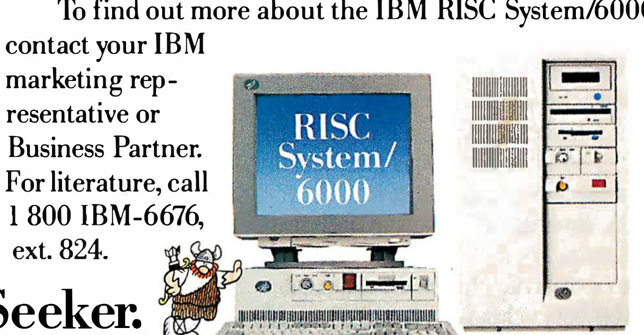
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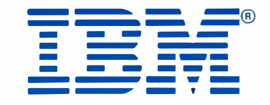
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The PowerPC Club: Not Just a Trio

Last October, when Apple and IBM finally released their plans for personal computing for the next decade, the details were scant regarding the so-called PowerPC, a planned single-chip implementation of IBM's RISC System/6000 processor. Other than that Motorola would manufacture the chip using its own 0.5-micron CMOS technology and 0.5-micron technology licensed from IBM, not much more was known.

Apple, IBM, and Motorola say that they will found an industry organization called PowerOpen that will be modeled after the 88Open group. The organization will actively solicit input (including standards definitions) from other companies in the industry. PowerOpen will define the instruction set for the PowerPC, the Application Binary Interface, and software interfaces. The three companies share a vision that the PowerPC will support the Mac and OSF/Motif operating environments.

According to Phil Hester, director of IBM's Advanced Workstation Engineering Division, the PowerPC RISC architecture has two targets: to get functional chips operating in 1992 and to scale up the chip by mid-1993 so that a high-end CPU more powerful than the current RISC System/6000 chip set will have most of its functions supplied in silicon, while retaining the 128-bit internal bus that gives the RISC System/6000 much of its performance. By 1995, the top-of-the-line model could be capable of 500 SPECmarks.

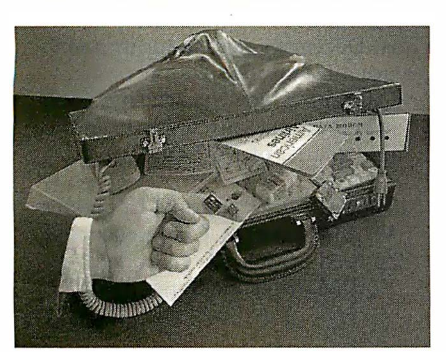
—Owen Linderholm and Trevor Marshall

Editor's note: *BYTE will have more in-depth coverage of the PowerPC in the February issue.*

New Chip Set Puts Your Office on an Airline Tray

An innovative chip set from Cirrus Logic squeezes the capabilities of a modem, a fax machine, and an answering machine into an area that's roughly the size of two postage stamps. Designed for low power consumption and minute form factor, the two-chip set could be an ideal solution for bringing complete telecommunications capabilities to notebook computers, the company says.

The CL-MD1424 Communicator intelligent data/fax/voice modem device set has the capabilities of a 2400-bps Hayes-compatible modem, a 14.4-Kbps Group 3 fax transceiver, and a voice answering machine. It can accept and store messages either through a standard telephone set or through the small speaker often found in a notebook computer.



The Communicator will work in environments such as Windows 3.0 and can operate the modem, fax, and answering machine in background mode. Machines built around the chip set will have the functionality of a fax machine, an external modem, an answering machine, a desktop computer, and a display monitor in a unit that can sit on an airline tray.

The company expects to ship the first samples of the set in the first quarter of this year. At press time, Cirrus Logic hadn't yet announced the names of any design wins, but systems using the chip may appear by the second half of this year.

—D. L. Andrews

NANOBYTES

Macronix (San Jose, CA) has combined a stripped-down version of its fax software with a **MaxLite** portable 9600-bps fax modem and a **Hewlett-Packard 95LX** to create what could be the world's smallest operational fax system. Macronix had to strip out all but the essential features of the program to fit on the HP 95LX's RAM cards. □



Visix Software (Reston, VA), maker of the graphical Looking Glass environment for Unix systems, is offering a new development environment that makes those systems friendlier. The HyperCard-style Unix interface lets you build graphical front ends to command-line programs. □

A ROM-based version of Microsoft Windows 3.1 is in the works, the company says. **ROM Windows** will run all your applications, but manufacturers will be able to configure it to fit on machines with scarce resources. □

Millions of people may soon be using OS/2 every day without even knowing it. Unlike earlier-generation machines based on proprietary hardware and operating systems, **NCR's** new line of automatic teller machines are based on 386SX computers running OS/2. □

A report published by **International Data** estimates that 3.8 million personal computers were shipped in the Asia/Pacific region in 1990, producing revenue of $12.4 billion. The report estimates that of that total, Japan alone accounted for more than 2 million personal computers. □



Microsoft, Lotus, and Phoenix to Team Up on Companion PC

Larger than a palmtop, lighter than a notebook, and selling faster than a Psion Series 3 or Hewlett-Packard 95LX—that's a description that the developers of the Companion PC hope will come true. The Companion PC is intended to be the small, full-function computer you take everywhere.

Combining products from Microsoft, Lotus, Phoenix Technologies, Intel, and Chips & Technologies, the Companion PC would run on AA batteries and cost under $1000. Unlike notebooks, it would be so light that you wouldn't have to think whether or not to take it with you. Unlike palmtops, the Companion would be a general-purpose machine with a full keyboard, weighing as little as 2 pounds. For a little extra money, you could add a 1.8-inch hard drive or solid-state storage. That's the idea, at least, if OEMs go along with the plan.

Phoenix, Lotus, and Microsoft have announced a cooperative program to help manufacturers build the Companion PC. System manufacturers can buy an integrated hardware/software reference design and BIOS from Phoenix, license DOS 5.0 in ROM from Microsoft, and buy ROM-based personal productivity software from Lotus.

With all these components in hand, manufacturers might not have much design work left to do. The real work may be in finding buyers who can distinguish one Companion PC from another.

—Ellen Ullman

OS/2 2.0: IBM Says Hold On Tight, It's Coming

IBM is now saying that its new operating system for the 1990s, OS/2 2.0, will ship this March. The environment will have the Workplace Shell and will run DOS, Windows, and 16-bit OS/2 applications unchanged. Windows applications will run side by side with DOS and OS/2 applications on the same platform.

But wait, you say. Didn't IBM promise to ship OS/2 2.0 by the end of 1991? IBM said it would. The system, however, would not have some of the functions that IBM has publicly demonstrated at various trade shows, such as the ability to run and cut and paste among Windows 3.0 applications, an IBM spokesperson said. The version planned for last December would have DOS capability and the Workplace Shell, but it would support only full-screen Windows applications. The spokesperson added, "A number of our customers have said that Windows doesn't fit into their plans and want [OS/2] 2.0 now."

—D. L. Andrews

Ballmer: Windows 3.1 Temporarily Delayed

At a breakfast for press and industry analysts, Steve Ballmer, Microsoft's senior vice president, announced a delayed delivery for Windows 3.1, demonstrated Microsoft's 32-bit Windows NT operating system, and explained the company's Windows strategy. Having once said that he would eat a floppy disk if IBM shipped OS/2 2.0 before the end of 1991, Ballmer was no doubt relieved that he did not have to breakfast on magnetic media.

Although all the planned features have now been built into Windows 3.1, it, too, wouldn't ship because of bugs, Ballmer said. Microsoft's internal estimates of the Windows 3.1 ship date range from an optimistic January to a pessimistic March, "which might really even be April," a source reported. In addition to fixing incompatibilities with Windows 3.0 applications, Microsoft will be adding the Media Control Interface and audio portions of the Windows Multimedia Extensions to the base 3.1 product. As previously announced, Windows 3.1 will include TrueType, Object Linking and Embedding, drag-and-drop capability, and a faster, more robust kernel.

Ballmer showed a misbehaved program called BadApp trying to crash Windows 3.1: Instead of the dreaded unrecoverable applications error, the new version of Windows brought up a box that lets you continue, save your work, and log the error. When the BadApp program deliberately hung up, a Ctrl-Alt-Del sequence let Ballmer close only the errant application and continue with the Windows session. Windows NT is the advanced portable operating system for 80x86 and Mips processors.

—Martin Heller

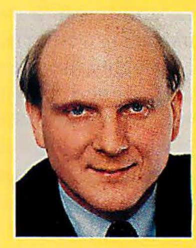
NANOBYTES

IBM has effectively disbanded its Desktop Software unit. The company has turned over the U.S. marketing and distribution rights for the high-end Platinum accounting and management system to **Advanced Business Microsystems**. XyQuest will market Signature, a DOS-based word processor jointly developed with IBM, and Claris now has the marketing and distribution rights for the Hollywood presentation graphics program. The Storyboard Live program is now in the IBM Multimedia Solutions division. □

Fox showed a technology demonstration of **FoxPro 2.0** for Microsoft Windows 3.0 at fall Comdex 1991. Likewise, **Borland** showed a glimpse of **Quattro Pro** for Windows. Borland expects to release Windows versions of dBase and Paradox this year and is now shipping a Windows-hosted version of Borland C++ 3.0. □

Unix Systems Laboratories has agreed to license Silicon Graphics' Iris Graphics Library. USL says that it will support Iris GL 5.0 in its Unix System V release 4.1 operating environment. □

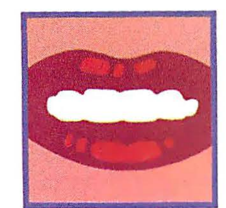
Microsoft's senior vice president **Steve Ballmer** says that IBM has confused software developers with its Apple alliance. "I could not say this a year ago, but they are even less clear than we are on their future direction," he said. □

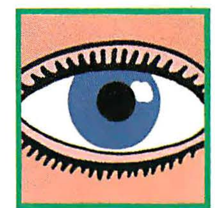


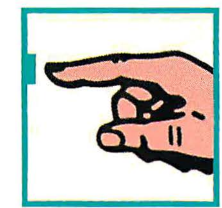
Quarterdeck has missed its projected December release for its ambitious Desqview/X environment. Quarterdeck now says that it expects to release the environment in the first quarter of 1992. □

The Fifth International Computer Virus & Security Conference will be held March 12-13 at the New York Marriott and Summit. □

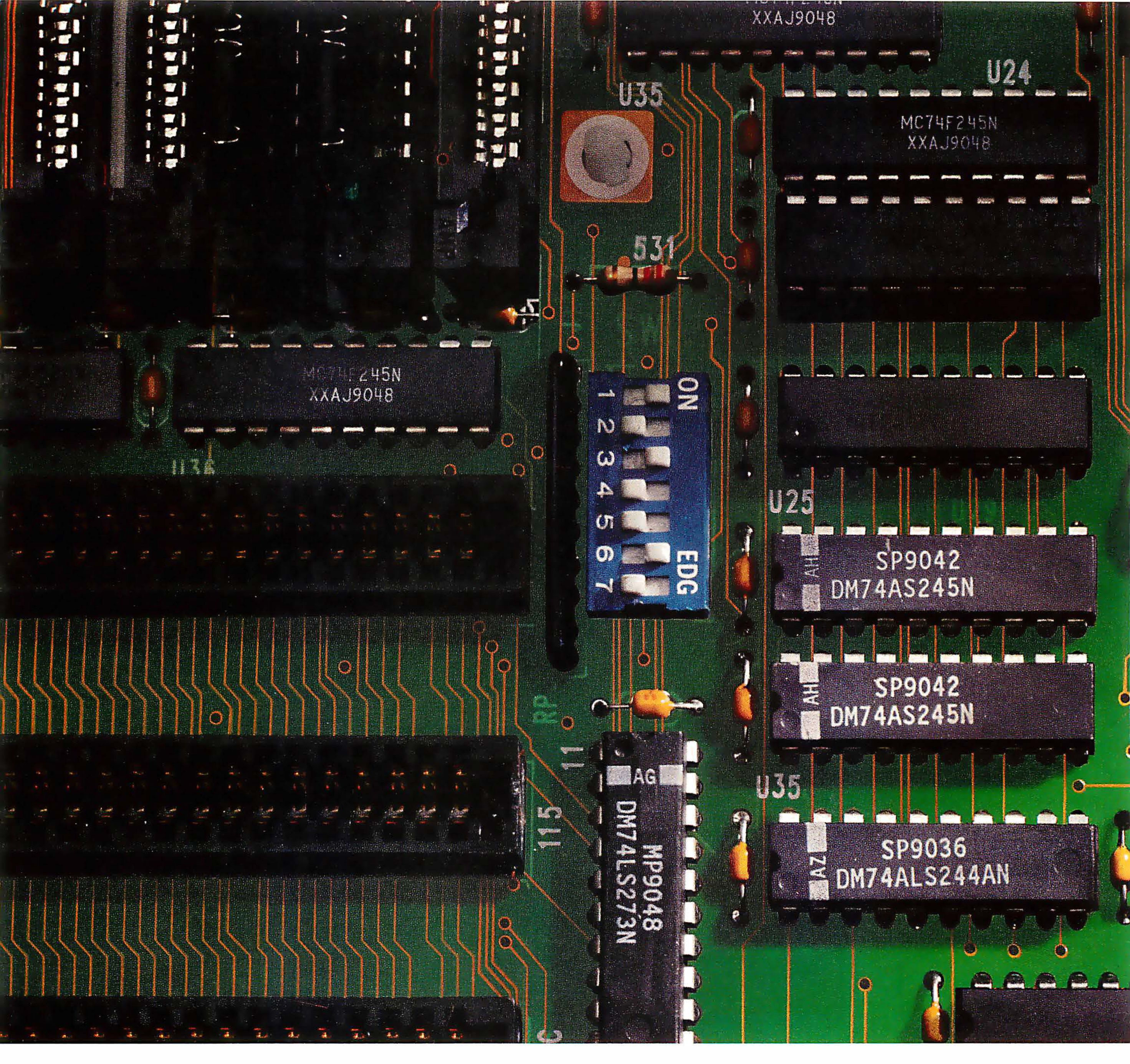












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Bacteria Could Lead to Drives with the Equivalent of 5000 Platters

Researchers seeking the storage medium of the future have found a promising source in nature. Bacteria living in salt marshes produce a molecule that could serve as a three-dimensional storage medium capable of holding a gigabyte of data per cubic centimeter.

The protein bacteriorhodopsin (bR), found on the surface membrane of halobacterium halobium, absorbs light in a process similar to photosynthesis. bR exists in two interchangeable 2-D states: one that absorbs blue light at 410 nm and one that absorbs green light at 570 nm. You can use the two bR states to store information in a binary code.

Researchers have worked with bR films since 1984. Dr. Thomas Birge, director of the Center for Molecular Electronics at Syracuse University, says that he has produced 1-inch-square polymer cubes, laced with uniformly oriented bR. "We now have access to a third dimension," said Birge. "It's as if you had a disk drive with 5000 platters on it." But since each layer is only 3 to 6 microns thick, the 3-D drive occupies almost the same space as a standard drive.

Birge begins with all the bR in the form that absorbs 570-nm light. To encode the information, he aims two infrared (1140-nm) lasers at a tiny region (3 cubic microns containing 10,000 proteins) of the cube. Each laser produces photons with half the energy of a 570-nm beam. Where the two beams meet, their combined photons convert the bR to its alternate form.

"To read it, we essentially write," said Birge. "Then we monitor the effect." As the bR changes forms, it emits a distinctive electrical signal. The bR cube is enclosed in glass, two sides of which are coated with a conducting film of indium-tin-oxide. Birge fires 10-ns laser pulses capable of altering the bR from its green-absorbing state to its blue-absorbing state. The green-absorbing bR will change and emit an electrical impulse; a blue-absorbing bR will not. A second laser pulse returns the green-absorbing form to its original state.

The ability to read the bR with electrical sensors makes the cubes less expensive than media that are read with optical ones, said Birge. The bR is harvested from bacteria grown in culture. "If our technology develops the way we hope it will, the price you now pay for 100 to 200 MB will buy multigigabyte drives," said Birge.

The bR drives are not particularly fast, however. Birge found that he could not maintain accuracy when he moved the laser beams between different regions of the cube. He has to move the cube instead, resulting in a 1-ms access time.

Finding a fast and accurate way to move the cubes is one obstacle to commercial production. So is scaling up the cube production. More problematic, said Birge, will be consistently detecting the electrical impulses emitted by the bR. The signal-to-noise ratio is now running between 5 and 10 dB, too low for commercially reliable signal detection. Applications could also be limited by the fact that bR breaks down at temperatures above 83°C.

—Billy Allstetter

Apple: TrueType Is Alive and Well

Sometimes a company does something in the marketplace that users can interpret in exactly the opposite way the company intended. Such seems to be the case with Apple. When Apple announced plans last summer to build Adobe's Type 1 font technology into a future release of the Mac operating system, some observers wondered if this meant that TrueType would become superfluous except to those select few running beta versions of Windows 3.1.

According to Brian Lawley, product manager for type and text at Apple, the company's commitment to TrueType remains as strong as ever. "TrueType will be the design center for [Apple's] next generation of type and imaging capabilities." He said that the installed base of TrueType is now "well over a million" and noted that the LaserWriter IIf and IIg printers come with a built-in rasterizer.

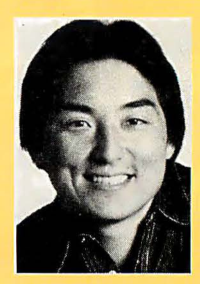
The whole point of the Apple/Adobe announcement was to tell you that eventually "Type 1 fonts will display and print without [your] having to buy ATM and use that separately." A recent coupon offer, where you could get ATM and four typefaces from Adobe for a $7.50 shipping fee, is an interim solution, Lawley said. He said that Apple's Type 1 TrueType strategy is that you "should be free to choose either format and know that it will work."

—Larry Loeb and D. L. Andrews

NANOBYTES

Information Builders, Inc., and **Apple** have signed an agreement that will let IBI's Enterprise Data Access/SQL client/server software provide Macs with a solution for accessing nonrelational data from a broad array of databases. ☐

Nantucket, provider of the Clipper 5.0 business application development system for the PC, now offers a **Cyrillic translation** that is produced in the Soviet Union. ☐



Guy Kawasaki, author of *Selling the Dream,* had this to say when asked if Apple's embrace of Adobe spelled the death of TrueType: "Do I think TrueType's dead? Well, was it ever born? Two years ago everybody said, 'Adobe's doomed.' Well, here it is two years later, and the world has reversed. So I guess the lesson is, if you wait long enough by the side of the river, all of your enemies will come floating by." He made the comments at a meeting sponsored by Milwaukee's North Shore Computers. ☐

Following layoffs of 1400 employees, a $70 million third-quarter loss, and the departure of several key executives, including former CEO Rod Canion, **Compaq** says that it will offer a line of **low-cost PCs** that may have processors from other chip manufacturers besides Intel. New CEO Eckhard Pfeiffer says that product design and development procedures have been changed to shorten development cycles and lower costs. ☐

UserLand Software has posted on major electronic networks the **Frontier Software Development Kit.** The SDK has sample code, libraries, documentation, and sample programs to help Mac developers take advantage of Interapplication Communication protocols. ☐


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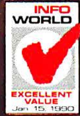
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GATEWAY 2000 — IT



For the first time in the six-year history of *Computer Shopper* magazine's Best Buy competition, one company swept all of the awards in the desktop PC categories. At COMDEX/Fall '91 in Las Vegas, Gateway 2000 was awarded Best Buy honors for 286, 386SX, 386 and 486 systems.

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"What's most meaningful about these awards," said Gateway 2000 President Ted Waitt, "is they are given by the readers of *Computer Shopper*, people who are buying and using PCs in the real world."

Shopper readers voted in record numbers: 15,000 people cast over 100,000 votes for products in 27 hardware and software categories. The vote on desktop PCs was a decisive victory for the Midwestern firm customers call the "cow company."

According to *Computer Shopper*, the Best Buy Awards have come to symbolize the best in service, quality, performance, support and product selection. This combination gives you the best value on the market.

Our thanks to Gateway's own Semi-Gold Dancers played by employees from departments throughout the company.

The Palmtop 386 Is Getting Closer

C&T plans to add new functions and power to the PC/Chip, pushing further the level of system integration. This June, the F8680 will add support for VGA displays, augmenting current CGA-compatible display controllers. There will likely be a 386-compatible PC/Chip in 18 months.

C&T is also exploring how the PC/Chip can offer programmable hardware gates, enabling OEMs to build PC/Chip-based devices that could be integrated into consumer electronics systems. With a programmable hardware gate, for example, an OEM could add support for an RCA jack. For the consumer, this would mean a hand-held PC that could plug into a home entertainment center.

C&T also has ambitious plans for pen support. According to C&T, it is working with Microsoft, GeoWorks, and Computer Intelligence on integrating pens into the PC/Chip environment, with Microsoft "at the top of the list." C&T will support the 32-bit interface of Go Corp.'s PenPoint system when a 386SX-compatible PC/Chip is ready. At that time, the company may divide its offerings into two branches: the low-end PC/Chip and high-end 386-based solutions.

—**Ellen Ullman**

IBM and Intel Fight Back with Chip Accord: First Products to Ship in Two Years

Both IBM and Intel have taken their share of lumps recently: IBM has been late to market with new PCs that turn out to be ho-hum when they finally arrive, and Intel is beset by both 386 chip cloners and RISC-chip competitors.

Now, it seems, IBM and Intel have realized that they are each other's best ally. The two companies have signed a 10-year technology agreement under which they will work together to enhance 80x86 architecture chips. Under the terms of the agreement, IBM will gain the right to manufacture 486 chips for internal use, as it has the 386. More important, IBM will be able to enhance current and future 80x86 designs and use the improved versions itself for four months before any other companies can have them. For IBM, which has lately had trouble differentiating its PCs from the sea of clones, this could provide a leg up in the market—in price, performance, or some other attribute.

Intel and IBM estimate that jointly developed products will be broadly available to the industry in about two years. The plan of attack calls for Intel to provide processor design and the 486 architecture, while IBM will add its semiconductor and systems design expertise. Both companies will provide design tools. For Intel, the agreement is a strong response to challenges from 386 cloners like AMD and Chips & Technologies. By tapping into IBM's silicon expertise, Intel may be able to deliver advanced processor designs faster than the cloners can keep up.

—**Andy Reinhardt and D. L. Andrews**

Next Moves in the Real World

It was a busy fall for Next and Steve Jobs, president and CEO of Next. Following a speech at the Unix Expo, Jobs admitted in a question-and-answer session that he hopes to take the company public in the next 12 to 18 months. One week after Jobs told reporters that he expected to sell $60 million worth of equipment in the last quarter of 1991 and that Next is profitable, the company announced that it would lay off about 30 people, or around 5 percent of the company's work force. While the layoffs were certainly not a minor event to those affected, Next's staff trimming was minute compared to the hundreds of people laid off at companies like Compaq, The Santa Cruz Operation, Grid Systems, and Ashton-Tate. In any case, a Next spokesperson said that the company continues to make a profit, "but in these times, you can't carry any extra weight."

The fact that Jobs was there at all was something of a surprise. Once upon a time, Next seemed to be trying to distance itself from the Unix community. Now, Jobs acknowledges and even accepts the idea that Next is a Unix company that must compete in the market against the likes of Sun, IBM, DEC, and Hewlett-Packard. In one example of Next's new openness, Jobs demonstrated a program that lets X Window System–based applications run in a Next window. ■

—**Andy Reinhardt and D. L. Andrews**

NANOBYTES

More than just an operating-system upgrade, **Apple** sees the new **A/UX 3.0** as the basis for the high-end systems that it will be releasing in the future, including those compatible with the PowerOpen platform the company is developing with IBM. The ability to run current Mac applications is crucial, an Apple spokesperson said. Programs running on the new version look just like regular Mac applications. A/UX 3.0 will also support TrueType fonts, the Data Access Manager, the new Finder, and Publish/Subscribe features. Balloon Help is also supported. □



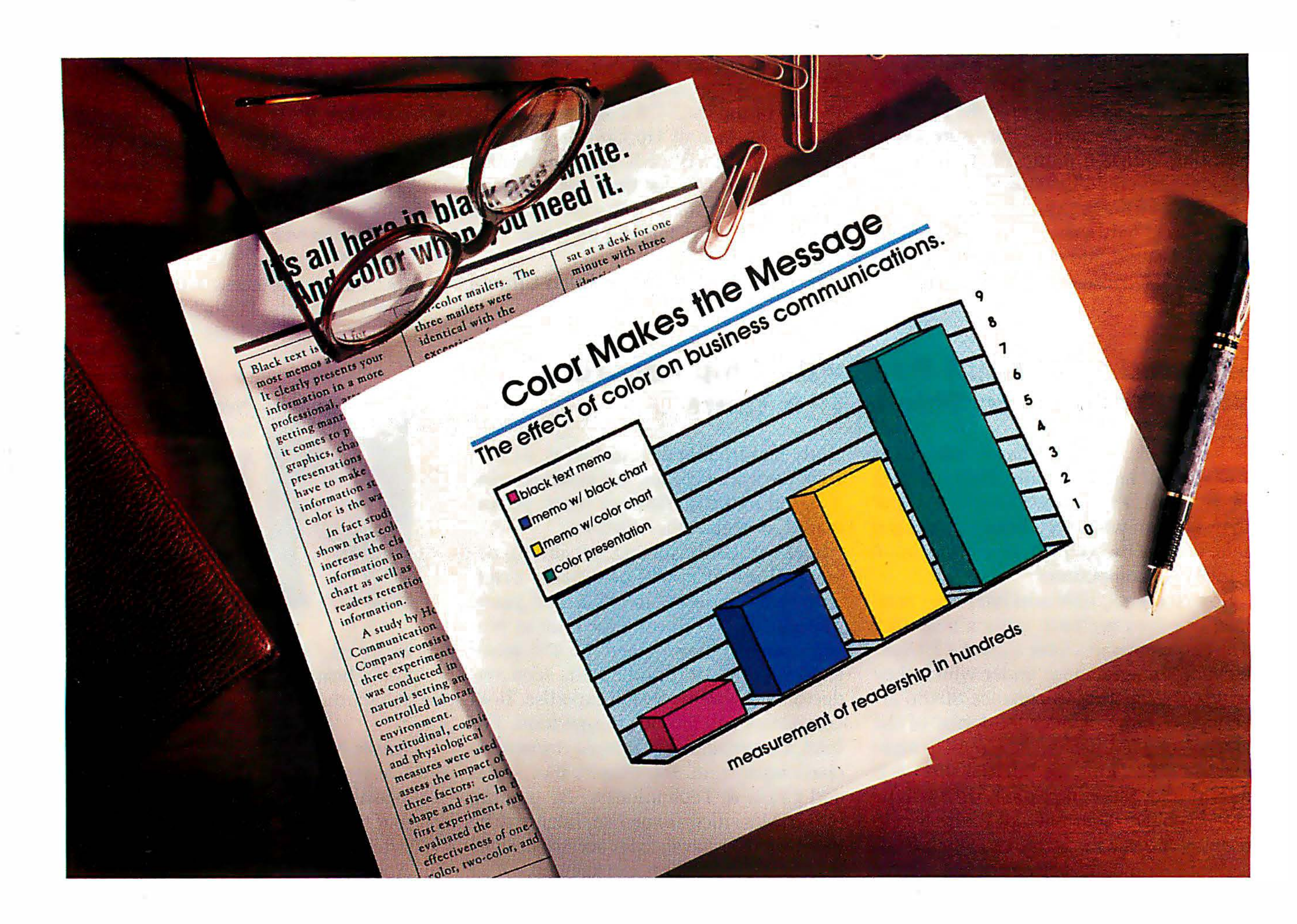
Next is acceding to customer requests for standards compliance. As president and CEO **Steve Jobs** flashed a slide covered with an alphabet soup of Unix acronyms, he joked, "I bet you never thought you'd hear Steve Jobs talking about standards." □

Apple has filed an appeal with the Court of International Trade in Washington, D.C., asking the court to reverse the imposition of a 62.63 percent tariff on imported screens. Apple argues that there cannot have been injury when there is no viable U.S. display industry to injure. □

Philippe Kahn, chairman, president, and CEO of Borland International, says that by 1995, most software companies will be programming in C++. But the language suffers from a standard garbage collector. Object systems, he says, tend to fill up quickly. □

Al Stromberg, president and CEO of Verbex Voice Systems (Edison, NJ), a maker of speech recognition systems, on why the market for speech recognition hasn't taken off yet: "You can't convince people they need a better mousetrap if they don't know they have mice." ■

What's the business world coming to?



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Psion's Powerful Pocketable

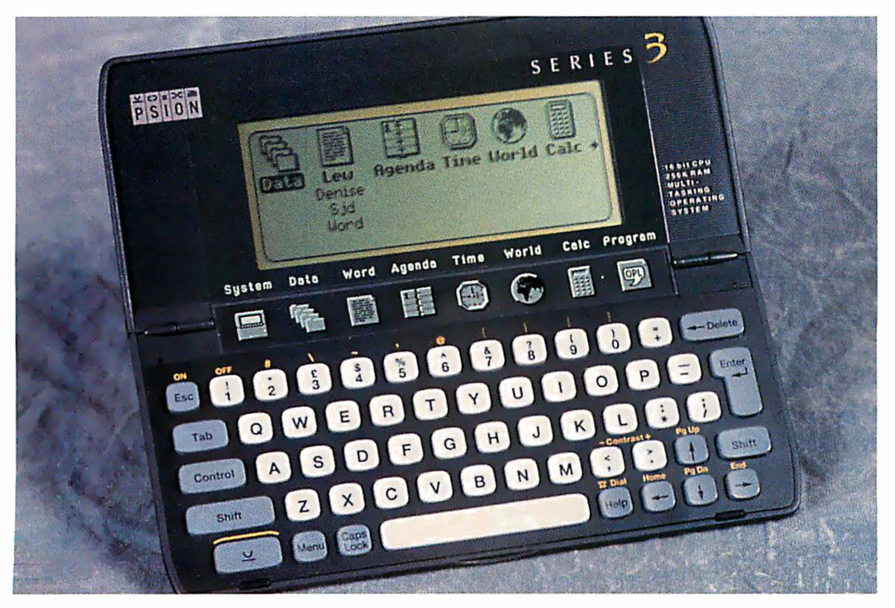
DICK POUNTAIN

A proprietary non-DOS operating system isn't a disadvantage when you have a raft of applications in the palm of your hand

Most people's first reaction when I show them the Psion Series 3 is quite simply, "I want one now!" This is not merely a technological gimmick. Psion has succeeded splendidly in designing a pocket computer with sufficient memory, battery life, and processing power to be genuinely useful. It's also easy to use. The Series 3 is not DOS compatible, but its excellent multitasking operating system is far more suitable than DOS is for a pocket machine.

The Series 3 exudes quality at first sight. The plastic case has an attractive matte gray finish and pleasing contours. At 6½ by 3¼ by 1 inch, it is smaller than an average-size wallet. Its weight, a bit over half a pound (including batteries), makes it quite pocketable. Although the clamshell-style case has no latch, it is held shut by spring tension. The toggle effect of a clever hinge causes the battery compartment at the rear of the case to swing downward and act as a rest that tilts the Series 3 to a comfortable reading angle.

The 8-row by 40-column LCD screen occupies the upper half of the case and rests at a shallow, fixed angle to the keyboard. Psion uses Hitachi's double retardation film LCD technology to get high contrast in all but the poorest of lighting. Battery life is about 120 hours using two AA alkaline batteries; a lithium battery is included as backup.



The Psion Series 3 crams all the parts and pieces of a full-fledged computer into a palmtop package.

Not for Touch-Typists

The tiny keyboard has a PC-style QWERTY layout, complete with twin Shift keys, a space bar, Control and Alt keys, and an inverted *T* cursor keypad (but no numeric keypad). The small square keys use elastomer switches and thus have short travel and almost no tactile feedback (an audio click is provided instead). The keys require quite firm pressure. Even the tiniest of fingers cannot touch-type on this keyboard. Holding the Series 3 in both hands and typing with two thumbs is more effective and very fast after a little practice.

Both ends of the case have a hinged flap that conceals sockets for Psion's proprietary flash memory cards, which behave like solid-state drives called A and B. The machine I used came with a 256-KB flash memory card. You can buy flash memory cards of up to 2 MB or static RAM cards of up to 1 MB. The file system is fully DOS compatible, even though the Series 3 doesn't run DOS programs.

The Series 3 is driven by a 4-MHz NEC V30 (80C86-compatible) processor, putting it in the IBM XT class in terms of power. The operating system and applications are held in 384 KB of ROM, and you can choose from models with 128 KB or 256 KB of main memory. This memory is employed far more efficiently than it would be under DOS. On the 256-KB test machine, I can run all seven built-in applications concurrently and have a 100-KB RAM drive left for data.

A Nonintimidating GUI

The Series 3 operating system works behind a simple GUI that I can only describe as brilliant. You can switch instantly between the built-in multitasking applications by pressing icons printed on a touchpad below the screen. The leftmost icon (System) puts you into a program manager with screen-based icons. Beneath each icon is a list of the files associated with that application, which you can pick with the cursor bar. Pressing the Tab key brings up an XTree-like file manager, complete with wild-card filters and file tagging. The operating system uses DOS hierarchical

directories and filename extensions, but it hides these from the casual user by automatically associating each application's files with a particular extension.

Inside each application, you press the dedicated Menu key to access Windows-style pull-down menus. Most menu options have key shortcuts using the Psion key. Psion has exhibited enormous ingenuity in making this interface intuitive and orthogonal. You can cut, paste, and copy among all the applications via a clipboard, or you can bring marked text from anywhere without losing the clipboard contents. You can also evaluate an arithmetic expression anywhere (e.g., in the word processor or database) by selecting it and pressing Psion-V.

Full-Featured Miniature Applications

The applications also reveal extraordinary attention to detail. The Series 3 word processor is powerful, with on-screen bold and italic, multiple printer fonts, and even Microsoft Word–compatible style sheets. There is a built-in outlining feature that works via styles; you can define an outline level for each style and then hide all text below a given level. Pressing the Word button toggles hiding on and off, and so collapses and expands the outline. When wisely used, this feature compensates for the small screen size; I use it more as a way of navigating through long texts than as a structuring tool. The Series 3 can drive a number of popular printers, including Epson, HP LaserJet, and Canon BJ-10e, directly via the optional parallel cable.

The Data application is a free-form text database that holds up to 4 KB per record, and you can optionally add field names, which can be toggled on and off down the left margin; the software is cleverly designed so that empty fields will not be displayed. Placing a telephone symbol at the beginning of any line will allow the Series 3 dialer to extract phone numbers from that line (DTMF tone dialing is performed via a small speaker under the Series 3's case, which you hold over a telephone mouthpiece). The phone dialer is cleverly integrated with the World application so that it can prefix the proper international code for an overseas call but omit it for domestic ones; you set "Home City" in World to tell the Series 3 which country you are currently in.

The World application is the best of its kind I've seen. Everybody knows how to display a world clock, but Psion has included a database of practically every country name (pre-U.S.S.R. breakup), and the major towns within countries too (over 70 in the U.S.). What's more, you can add your own towns, with map references, time-zone offset, and phone code. As you browse or search for a town, the cursor shows its position on the world map, together with the local time, phone code, times of sunrise and sunset, and distance from your current home city. Travelers will buy the Series 3 for this feature alone.

The Agenda application includes the functions of calendar, two-week planner, appointments diary, alarm, and to-do list. The one-month calendar and two-week time planner appear on the same screen, through which you navigate using the cursor keys. Pressing Enter switches to a day diary screen with slots for 14 items. You can repeat appointments (by date or day of week), and you can archive old appointments instead of just deleting them as most time planners do. There is a separate screen for day notes, and a to-do list that rolls over tasks from day to day until you remove them.

I enjoyed the surreal experience of downloading my BIX mail into something not much bigger than a bar of soap.

Communicating with the World

You can communicate with desktop machines and modems via a tiny connector on the left side of the Series 3, using a special cable with a "lump" halfway down it that actually contains the RS-232 circuitry and some ROM programs. When plugged in, this lump appears as drive C to the operating system. When you run Psion's MCLink program on your desktop PC, the PC's drives (named REM::A:, REM::C:, and so on) become directly accessible from the Series 3 as a full network-style remote file system. Drive C also contains a communications program with a full script language based on OPL and prewritten scripts for BIX, CIX, MCI Mail, and more. I enjoyed the surreal experience of downloading my BIX mail into something not much bigger than a bar of soap.

The Psion Series 3 is the first pocket computer that I've found genuinely useful, and I shan't leave the house without mine. One criticism is that Psion's flash memory cards are not PCMCIA compatible; however, I don't believe this will prove fatal. Most users will find that a flash memory card is more like a permanent expansion than a removable medium and will not be purchasing any in quantity. I find that the 256 KB of internal memory and a single 256-KB flash memory card handle all my business easily, using my desktop PC to back up and archive. The Series 3 won't replace a notebook PC for power spreadsheet users, but it might replace the rest of the contents of their briefcases. ■

Dick Pountain is a BYTE consulting editor based in London. You can contact him on BIX as "dickp."

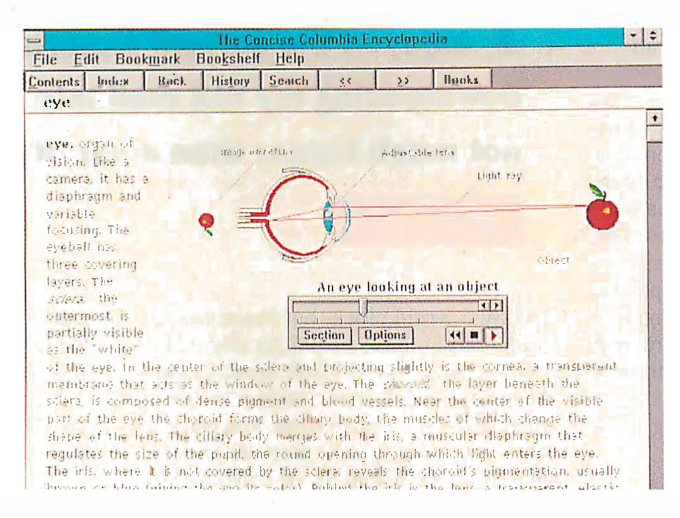
THE FACTS

Psion Series 3
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Bookshelf Goes Multimedia

Available since 1987, Microsoft's CD-ROM-based Bookshelf has become an invaluable reference tool for writers and students. Its dictionary, thesaurus, and other sources have been reason enough for thousands of people to invest in a CD-ROM drive. **Microsoft Bookshelf for Windows** is the next generation, adding the splash of multimedia sound, graphics, and animation—assuming you have a multimedia-ready PC.



Bookshelf for Windows contains both plain-vanilla DOS and Windows versions of the program, so you don't need multimedia facilities in order to use it. Both versions contain *The American Heritage Dictionary*, *Bartlett's Familiar Quotations*, *The Concise Columbia Dictionary of Quotations*, *The Concise Columbia Encyclopedia*, *Roget's II: The New Thesaurus*, and *The World Almanac and Book of Facts*. The Windows version, which takes advantage of Microsoft's new Multimedia Extensions for the graphical environment, also contains an electronic version of *The Hammond Atlas of the World*. And that's the first hint of this rendition's greater powers.

The DOS version of Bookshelf has no atlas because it can't do graphics: It's a text-only product. The atlas included with Bookshelf for Windows has, among other features, topographic maps of any region of the globe you choose, shown in 256-color VGA resolution. Other animations can be found in the encyclopedia; some are accompanied by sound lectures that explain and augment the video. The mouse can be used to jump to any part of the animation as well as to control the speed at which it plays back, and all the animations in the encyclopedia can also be accessed directly from a list of animations at the top of the "book."

I particularly enjoyed one listed as Solar System, which shows the planets revolving around the sun, as well as the movements of comets and meteoroids. A voice-over lecture describes the action. Sound is also a feature of the dictionary. It will pronounce the word for you if you click on a megaphone icon in the upper left corner of the definition screen.

Information searches are also possible with both versions of Bookshelf, but here again the Windows version is more flexible. It lets you search all the books at once or deselect some books. The DOS version allows searches only across like books (i.e., the quotation books or the encyclopedia and almanac) for specific terms. The Windows version also allows searches by keyword or topic.

Further, because Windows allows multitasking, it's possible to cut and paste information from a Bookshelf book into any other active Windows application. And that brings me to another neat feature of Bookshelf for Windows: QuicKeys. Essentially a macro generator, QuicKeys is a separate application that comes with Bookshelf and is installed by Setup. It lets you define key combinations that take you directly from any active Windows application to a Bookshelf book and begin a search for whatever word is highlighted in your application. Each book has a unique key combination. Using QuicKeys lets you avoid using the Bookshelf group window to access any of the books.

Also included in Microsoft Bookshelf for Windows are two features that make the package more useful the more you use it. Annotations let you add your own personal notes to any topic in any book. (You can also copy annotations to the Clipboard and use them elsewhere in Windows.) Bookmarks, as the name implies, let you mark a location, setting up a list of frequently accessed topics anywhere within Bookshelf. This lets you go directly to the topic at any time without having to go through the whole search process again.

Bookshelf for Windows is easy to use, but there's a lot to it. To help you get started, there's a well-designed and extensive tutorial that (not surprisingly) makes extensive use of multimedia.

Needless to say, multimedia is in its infancy. Microsoft says that more features are on the way in the next version. According to David Cornfield, lead engineer/program manager for Bookshelf, proposed changes include programwide support for 256-color graphics, instead of the 16-color graphics that are now found everywhere but in the topographic maps. The mix of books on the next release of Bookshelf for Windows may also change.

For now, to run Bookshelf for Windows in all its glory, you need Windows 3.0 with Multimedia Extensions 1.0, MS-DOS 3.1 or higher, Microsoft CD-ROM Extensions 2.2 or higher, a CD-ROM drive, and an audio card (e.g., Media Vision's Pro-Audio Spectrum or cards made by Ad Lib). Bookshelf for Windows works without Multimedia Extensions and the sound card, but you won't get those fun animations or voice-overs.

Microsoft Bookshelf for Windows is an intriguing hint at the future possibilities of multimedia. While the sound and graphics are entertaining, they're only a small part of the program. Still, the wealth of resources on the Bookshelf CD-ROM makes it a truly useful—and highly recommended—tool, whether your PC has multimedia capabilities or not.

—Robert E. Calem

THE FACTS

Microsoft Bookshelf for Windows
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Highlights

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The Pac Is Back

Good ideas don't always become successful immediately—if ever. Sometimes it takes a while. Such is the case with Tandon's **PacII** computer. As Yogi Berra is purported to have once said, "It's déjà vu all over again." If the boxlike module that's sticking out of the computer in the photo looks familiar, that's because Tandon introduced the Pac hard drive concept way back in 1987.



It sounded like a great idea: shock-mounted hard drive cartridges that could be moved from machine to machine or locked away overnight. Although Tandon sold quite a few of them to government agencies and in the international market, the Pac never went over as a mass-market item, largely because the original version used the 5¼-inch floppy drive that was standard back then, making the Pac large and clunky.

Technology has finally caught up with the Pac idea. The new Pacs are smaller, lighter, and easier to handle because they use 3½-inch drives. In addition, today's hard drives are considerably more reliable and shock-resistant. Better late than never.

More and more hard drive makers are introducing removable and transportable hard drives, in a variety of forms. But Tandon was there first, and it's obvious that it has done a great deal of work to perfect the concept.

The MFM and RLL drives used in earlier Pacs have been replaced with higher-performance SCSI drives. Both the 40- and 400-MB drives in my review unit had respectable average access times of about 18 ms.

You can't eject the drives until they've spun down and (automatically) parked their read/write heads. You can also use a software command to keep the drives from being ejected by an unauthorized person.

But there's more. Tandon has integrated the Pac idea into a system that can truly be called modular. Unlike the raft of competitors that let you easily upgrade just the processor, the PacII uses a building-block approach that lets you tailor a system exactly to your needs. Need a more powerful processor? Plug in a new card. A larger hard drive? Plug in a new Pac. You can even add a second dock for an additional Pac. Even the floppy drives are modular. If you need a second one, it snaps on atop the PacII's case.

The PacII's processor, as with so many other "expandable" systems, is on an add-in card that contains the necessary peripheral electronics for the processor that you are using. The processors range from a 386SX/16 up to a 486/33. (A Tandon spokesperson said that a 486/50 should be available by the time you read this.) Prices for the individual processor module upgrades weren't available at press time, but Tandon has promised to price them so that upgrading doesn't cost you as much as a brand-new system.

The PacII is a solidly built, high-quality system. Obviously, to make the system as modular as it is, Tandon had to design it from the ground up, and the quality shows. Priced not much higher than your garden-variety generic clone, the PacII is engineered and built completely by Tandon. The system that I tested came with a 486/33 processor and both 40- and 400-MB hard drives. BYTE Lab benchmark results were solidly in the midrange of what I'd expect for a well-engineered system, neither the fastest nor slowest we've measured.

The importance of system expandability is the subject of lively debate in the PC community. Every company with an expandable system also has surveys showing that virtually everyone wants to upgrade his or her system regularly. I tend to doubt it, especially with systems that upgrade only the processor. Many users need a faster and higher-capacity hard drive before they need a new processor.

Tandon's full-system expandability design makes a lot of sense, and the PacII looks like it's destined to become the system of choice for users who want the option of essentially snapping together systems from matched parts and pieces. It's especially attractive for corporate environments, where a central store of expandable and interchangeable parts can be kept ready for instant access.

Then there's the hard drive concept. It looks like its time has come. Tandon will also have internal (InPacII) and external (SidePacII) docks for Pacs that will let you add Pacability to existing systems. If you have systems in several locations, carrying a Pac (they weigh from 2.7 to 4.4 pounds) with all your work between locations is a logical match to the way that many of us do our work these days.

—Stan Miastkowski

THE FACTS

PacII
Basic system: 386SX-20, $2686; 386SX-20 with cache, $2886; 486SX, $3211; 486/33, $4521
Hard drive Pacs: 40-MB, $349; 100-MB, $599; 200-MB, $799; 400-MB, $1799

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This Lunchbox Isn't for Twinkies

If you plan to buy the **Dolch P.A.C. 486-50E** portable computer, you'd better have some serious work for it to do. With its 50-MHz 486DX processor, 8 MB of RAM (expandable to 32 MB), and a standard 200-MB SCSI hard drive with a caching controller, the 18-pound 486-50E is designed for people who often bite off more than they can chew.



On the outside, the 486-50E is the same Dolch P.A.C. we've reviewed before. The removable keyboard is a cross between the classic 84-key IBM AT keyboard and the Enhanced model. Twelve function keys run across the top, and the Escape key is part of the combined cursor/numeric keypad. The standard gas-plasma monochrome display is sharp and clear. I was able to use this computer for hours without a hint of eyestrain. If you prefer, the 486-50E is available with a Hitachi active-matrix thin-film-transistor color LCD (see "Full Color Comes to LCDs," August 1991 BYTE).

Pop open the lid, and you'll find that the 486-50E is no cream puff. The motherboard has the 50-MHz 486 processor (a 128-KB cache is optional), eight SIMM sockets, three ISA slots, and three EISA slots. Of these, three slots are used by system boards: One holds the EISA SCSI controller with a 4-MB RAM cache on-board, another has the 16-bit VGA card (with 1 MB of video RAM), and the third has the serial/parallel interface. Getting to the slots to add boards is a simple matter of removing three screws. The 225-watt power supply should be more than ample for any boards you're likely to add.

The 486-50E comes standard with a Conner Peripherals 200-MB SCSI hard drive and a 3½-inch 1.44-MB floppy drive. There's no room to add further storage, but you can buy the machine with a larger hard drive. I found the 200-MB drive and the 4-MB caching controller to be an effective combination.

Have you ever seen Windows run in real time? The 486-50E is the *only* machine that I've seen run Windows without noticeable delays. The CPU is running only 50 percent faster than a 33-MHz 486, but it seems much faster than that. On the low-level BYTE benchmarks, the 486-50E turned in excellent results. I tested it next to a Mylex-made 486/33. With a Compaq Deskpro 386/20's performance as 1.0, the Mylex 486/33 had a CPU index of 3.49; the 486-50E had an incredible 4.42. The FPU index of the Mylex was 4.61; the 486-50E's was 6.91.

When you stop to think about it, this latest addition to Dolch's product line seems just a bit eccentric. The thought of carting a $17,000 computer through the slings and arrows of everyday use makes my head spin. (Can you imagine anyone checking this machine as airline baggage?) But obviously, there are uses for a portable computer whose processing would have been unthinkable just a couple of years ago. It's obvious overkill for garden-variety computing tasks like word processing and spreadsheets.

Face it, this is a machine for power users and those affluent "early adopters" who want the latest and greatest status symbol. I wish I had the bucks and an excuse to buy one.

With the P.A.C. family of portables, Dolch has hit upon a combination of features and performance that works. At $16,995 for the basic model, the 486-50E isn't a machine for everyone. It's expensive, and the 50-MHz processor is going to spend a lot of time idling unless you do serious CAD, database, or modeling work. But for users with caviar tastes, the Dolch P.A.C. 486-50E is a machine to savor.

—Howard Eglowstein

THE FACTS

Dolch P.A.C. 486-50E
$16,995

Dolch Computer Systems
372 Turquoise St.
Milpitas, CA 95035
(800) 538-7506
(408) 957-6575
fax: (408) 263-6305
Circle 1212 on Inquiry Card.

More Than the Sum of Its Parts

Remember "integrated software"? That term was all the rage a few years ago and then (thankfully) died a quick and merciful death. It sounded great in theory: Applications worked together in a supposedly seamless manner, letting you easily switch among common applications and share data. Most of the integrated packages quickly disappeared because the individual applications often lacked key features and getting them to work together seamlessly was seldom easy.

After all these years, I've finally used a truly integrated software environment. And somehow I'm not surprised that it's for the Mac. Claris, Apple's software subsidiary, has just released **ClarisWorks,** which integrates word processing, graphics, spreadsheets, charting, database management, and communications into an application that is really and truly seamless. And it works.

The beauty of ClarisWorks is that it doesn't force you to switch among various "modules." Instead, you can access all the tools and features from within a single document simply by clicking on



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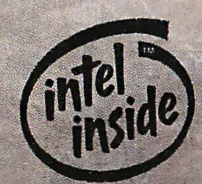


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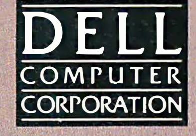
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NEWS

FIRST IMPRESSIONS

icons in a toolbox. For you PC aficionados, it's not unlike Microsoft's Object Linking and Embedding, which will be an integral part of Windows 3.1, except that, in ClarisWorks, it's here now.

Even though the term *object* has been much overused of late, it does much to explain how ClarisWorks does its job. Each application is an object that communicates with other objects from a *document*, which is the basis of ClarisWorks. A document doesn't necessarily have to be text; you can start out in any application and add other text, graphics, calculations, or charts to it at any time.



ClarisWorks sells for a very reasonable $299, so you wouldn't expect each application to have every feature under the sun, and they don't. But I don't see that as a problem. Raging featuritis is a big problem in the software industry, with the vast majority of users never needing anything but a small subset of the features in their numerous—and expensive—packages.

In fact, each individual module in ClarisWorks is a subset of a well-known Claris application (e.g., MacWrite Pro, MacDraw Pro, Resolve, and FileMaker Pro). It's how Claris picked the most-needed features and got them to work together that's the real news here.

Overall, ClarisWorks gives you the Mac's WYSIWYG approach in all the modules. The word processor is more a desktop publisher than just a way of getting words on paper. Besides having a spelling checker and thesaurus, it allows advanced layout functions (e.g., multiple columns). The spreadsheet has 96 built-in functions, more than most folks will ever need. And you can create and save your own. Of course, the charting application lets you create a variety of charts and graphs from the data.

Even though I do the vast majority of my work with words, one of the interesting things I found about ClarisWorks is that I kept gravitating to its graphics capabilities. Of course, Mac users tend to be a visually oriented group, trained from that ubiquitous Mac GUI on up. The Claris folks have made it so easy to integrate graphics elements into your documents (whatever they may be) that I found myself making charts from boring spreadsheets and popping pictures into documents. That surprised me, because (as a writer) I normally don't think in graphical terms. It's obvious that getting you to think graphically is a key aim of ClarisWorks. Even if you're not graphics-oriented, ClarisWorks will subtly ease you into it. It's not touted as a presentation graphics package, but that's another thing that it shines at. I used ClarisWorks to quickly whip together a presentation and print it to overhead transparencies on my laser printer.

The flat-file database uses FileMaker's "book" metaphor, which I've found to be incredibly intuitive. And the communications package has all the features I'd ever need for communicating via modem.

ClarisWorks comes with a number of helpful manuals, but I found that I seldom needed to pick them up. That's because a Hyperhelp system keeps all the help you'll ever need on-line and easily accessible from anywhere in the package. There's also an on-line tutorial that's designed for first-time Mac users. One manual that I did find particularly useful was a small book intriguingly titled *Possibilities*. It's full of ideas for using ClarisWorks for day-to-day work.

One of the features I like best about ClarisWorks is a selection of over 20 XTND translators. These let you open, insert, save, and edit files from a wide range of the most popular applications across different platforms. Because ClarisWorks is so useful, I found myself importing documents from PC-based applications, working on them, and exporting them back to our in-house network.

This package isn't designed to be all things to all people, but it's perfect for a wide variety of users, from small- to medium-size businesses to students. It's also perfect for users of the newest Mac portables, since it lets you carry all the most-used applications in a minimum amount of disk space. New Mac users will also find ClarisWorks a perfect place to get started. You can be doing productive work with your Mac minutes after opening the box. And for those who are destined to become true power users and eventually might need the advanced features in other Claris packages, ClarisWorks is a perfect training ground.

Of course, ClarisWorks isn't the only integrated program available for the Mac, but I have to conclude that it's far and away the best. Claris is serious about harvesting the universe of Mac users who are currently with competitors. If you use Microsoft Works, Symantec GreatWorks, or RagTime, you can upgrade to ClarisWorks for $99. (The same holds true for AppleWorks users.)

I'd estimate that all but the most feature-hungry Mac users will be able to get 99 percent of their work done using ClarisWorks. The package works on all Macs from the Plus on up and is System 7.0 compatible. I tested the prerelease version on a Mac SE/30 and found it to be very fast.

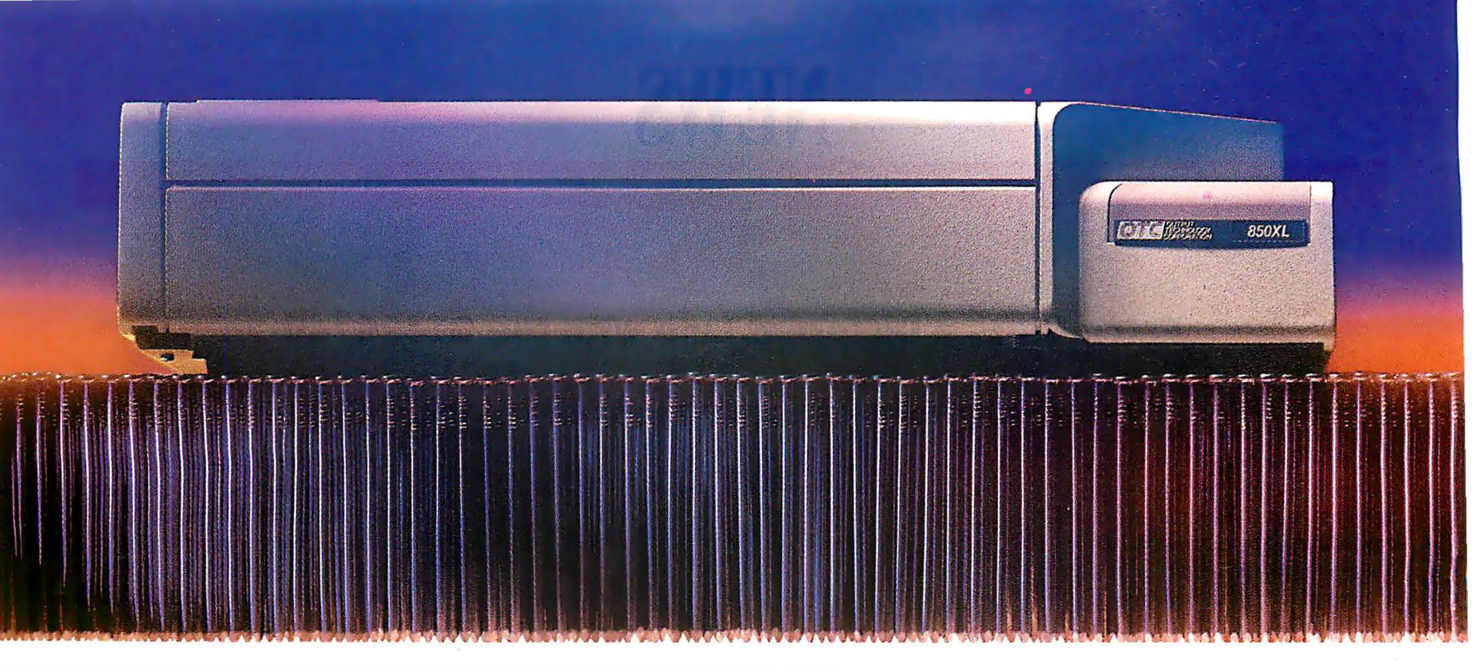
I have both a PC and a Mac on my desk, and I must admit that my Mac was formerly used for a small portion of my workday. But since I installed ClarisWorks, that's changed. If you want to get some work done without hassling with multiple packages under various GUIs, ClarisWorks is the best excuse I've seen yet to go out and buy a Mac.

—Stan Miastkowski

THE FACTS

ClarisWorks
$299

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5201 Patrick Henry Dr.
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Falco Blurs a Different Line with the GT486/40



Falco Data Products says that its **GT486/40** further blurs the line between desktop computers and graphics workstations, but I disagree. After spending a few days with this mighty mite (13 pounds) of a system, I'll lean the other way and say that it blurs a different line, the one between desktop computers and notebook PCs. The GT486/40 is about half as tall (2¾ inches) as a can of Jolt. Until you realize that a metal case under the plastic exterior is providing extra support, you wonder why the monitor does not crash right through the unit's housing. Don't be misled by this unit's size, however: It's small, but it offers performance that's more than suitable for CAD, desktop publishing, and graphics applications.

It's not actually a 40-MHz 486 processor inside the machine, of course—there is no such thing. But Falco's integrated design and consideration for aerodynamics let the 486 chip run faster than the rated 33 MHz. The GT486/40 has two thermostatically controlled fans that keep the unit running at a low temperature. Each component within the case acts as an active element in the cooling design, providing an air crossflow system that moderates the heat of the CPU as well as that of expansion cards, memory chips, and disk drives. The cooling system and integrated design provide an upgrade path to a true 50-MHz 486 processor when it becomes available.

Warning: Do not run the machine for an extended period of time without the cover, because this will throw the cooling system out of whack and can cause the system to overheat. Closing the cover forces air through the system. As I was testing the Falco, I did remove the case to run the BYTE benchmarks, and I noticed that components of the machine soon became very warm. A Falco representative said this was not a good thing to do.

The base model sells for $2909. It features a Super VGA Video Electronics Standards Association graphics card supporting up to 1024- by 768-pixel noninterlaced resolution, 32,000 colors, 1 MB of RAM, and a 3½-inch 105-MB SCSI hard drive. The unit that I tested was the $6042 top-of-the-line model. It includes 32 MB of RAM, a 3½-inch 426-MB SCSI hard drive, an 8514/A graphics card with integrated VGA and support for 1024- by 768-pixel noninterlaced resolution, 1 MB of video RAM, and a 15-inch Super VGA color monitor.

The 2.88-MB floppy drive, compatible with 1.44-MB and 720-KB formats, lets you store large graphics files. The high-capacity floppy drive lets users of CAD and other applications copy large digital images or design files to a floppy disk. An external SCSI-2 port supports up to six peripherals, letting you add storage options such as CD-ROM, optical disc, and streaming tape units. Because of the GT486/40's low profile, you get only three 16-bit expansion slots, one of which is occupied by the graphics card.

All the GT486/40 models have an additional 256-KB write-back static RAM cache as a standard feature. In the write-back cache scheme, data in the cache is not written to memory until it needs to be removed from the cache or until another part of the system requests it. The write-back scheme is faster than other implementations (e.g., write-through).

On the low-level BYTE benchmarks, the GT486/40's performance placed it at about the midpoint between a test 50-MHz 486 unit that we had in the BYTE Lab and a Mylex-made 486/33 with a fast but non-cached SCSI drive. For example, on the CPU test index, the GT 486/40's performance rated almost four times faster than a Compaq 386/20 machine (I performed the benchmarks with the system's cover in place so that the machine could deliver maximum performance). To give you an idea of how fast that makes it, the GT486/40 opened a 50-page document created in PageMaker 4.0 for Windows in less than 4 seconds. Performance like that will be a blessing to anyone who has waited as his or her hard drive trundled seemingly into the night on a graphics file. The GT486/40 didn't quite make Windows run in real time, but it gave it a swift kick in the pants.

I hesitate to say how small and portable the GT486/40 is, because it's a graphics workstation with a small footprint and isn't designed to compete in the portable market. But it wouldn't surprise me if GT486/40 owners decided to shell out a few hundred extra dollars for another monitor and carried the system back and forth between their home and workplace. I took it home with me one night, and if it weren't for the monitor, I wouldn't have thought twice about it. The Falco's small footprint occupied about as much space on my home desk as a laptop but with a much better monitor. If your home desk is as cluttered as mine, with the GT486/40, you're in luck. The GT486/40's diminutive size made me wonder if the firm is working on a docking-station version. With the GT486/40, it seems that Falco is more than halfway there already.

—D. L. Andrews

THE FACTS

GT486/40
$2909 to $6042

Falco Data Products, Inc.
440 Potrero Ave.
Sunnyvale, CA 94086
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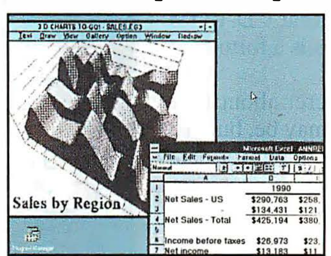
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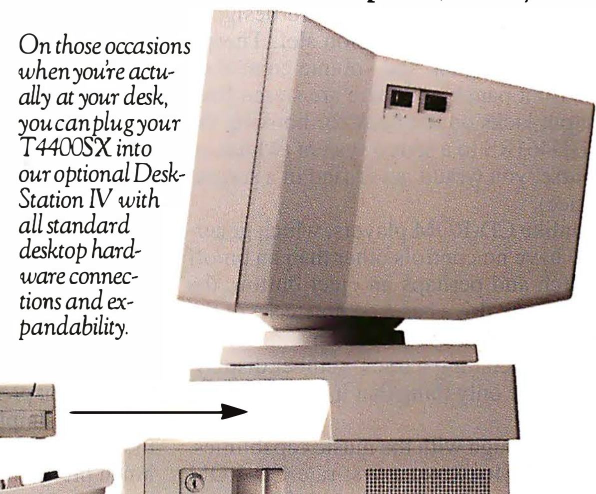
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A Dual-Personality CD-ROM Player

As the variety of available software increases and prices decrease, CD-ROMs are finally becoming viable (read "useful") software tools. Thankfully, prices of both internal and external CD-ROM drives are also falling. This is a fortuitous combination indeed.

There's a dirty little secret about CD-ROM drives. Useful they may be, but just about nobody I know uses them for data full-time. In fact, according to Philips, "research indicates a CD-ROM drive is used in its computer peripheral capacity only about 10 percent of the time." What about the other 90 percent of the time? They're used for playing music.

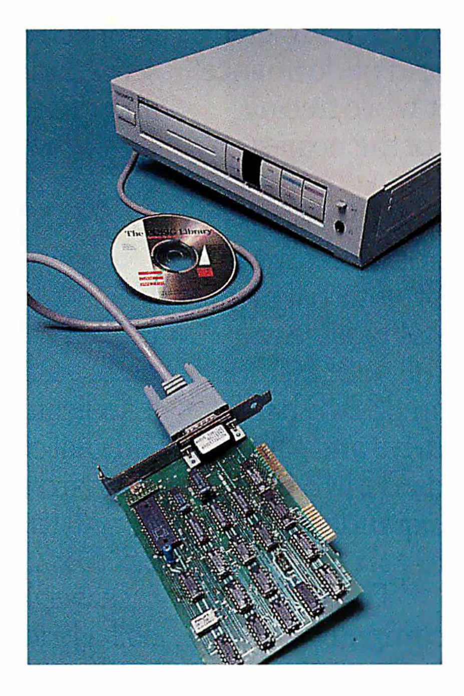
Most CD-ROM players are designed (not surprisingly) for handling data; playing music CDs is often a pain. With the **Magnavox CDD461RS**, Philips has designed a CD player that you can use for a computer instead of a computer peripheral that can also play CDs.

The Magnavox drive looks more like a CD player than a computer peripheral. But a peripheral it is, with a SCSI port in the back hooked to an add-in card designed for any 8-bit PC expansion slot. There's a headphone jack and volume control on the front panel, and there are stereo line-output jacks on the back for hooking the CDD461RS to a stereo system (which, of course, you would never find in a serious office).

Unlike CD-ROM players, which generally have no controls other than an on/off switch and perhaps an eject button, the Magnavox drive has a complete set of the type of controls you'd see on a music CD player, including a track-number display. About the only thing that it lacks is a time display.

OK, enough with the music capabilities. The CDD461RS is a first-rate CD-ROM player. Its size, heft, and rugged construction mean it will endure full days of hard work.

Installation was a breeze. The add-in board has a single jumper for setting the memory address. The factory setting (340 hexadecimal) works in all but the most loaded systems. Then it's a simple matter of connecting the cable between the board and the drive. On the software side, the Magnavox drive comes with an easy-to-use installation program that installs a device driver for the player and the latest flavor of Microsoft's CD-ROM extensions to MS-DOS.



The prerelease unit that I tested came with a variety of CD-ROMs, including the New Grolier Electronic Encyclopedia, Microsoft Bookshelf, and the PC Globe Electronic Atlas. It also includes the PC-SIG Library—a gold mine of hundreds of public domain and shareware programs. It's a great introduction to the wealth of material available on CD-ROM. A Philips spokesperson says more CD-ROMs will be shipped with the final version of the player at no extra cost.

The CDD461RS doesn't use the cartridge-like CD-ROM carriers that are prevalent with most players these days. Instead, you press a button and a tray slides out. You simply place the CD-ROM on the tray and slide it back into the player. I much prefer this system to the CD-ROM cartridge approach, especially because extra cartridges are expensive and difficult to find. Most cartridge users end up using a single cartridge and continually changing the CD-ROM, which is a genuine pain.

On the technical side, the average seek time of the CDD461RS is about 700 milliseconds. That's pretty much par for the course for today's generation of players. But a more important measure is the drive's average transfer rate, which is a bit over 150 KBps. That figure means that the Magnavox drive is fast enough for intensive multimedia applications, where data (e.g., animation) needs to get to the processor in a fast and continuous stream.

In fact, it's the CDD461RS's multimedia capabilities that make it intriguing, and an excellent investment for the future. As the MPC (Multimedia Personal Computer) standard becomes widespread, as it's sure to be, you'll see more and more CDs that mix computer data along with music. As I was completing this First Impression, I received a copy of Microsoft's "Multimedia Beethoven." It's a tantalizing glimpse of the future of mixed-media CDs.

In the course of doing this First Impression, I tested the CDD461RS extensively with both audio disks and CD-ROMs. It performs admirably for both jobs. One advantage of the high-tolerance laser-positioning electronics needed for reading CD-ROM drives is that they also do a bang-up job of reading even the most finicky music CDs. And in another bow to the music-player orientation, there's even a handy "shuffle" button that plays cuts on a music CD in random order.

Philips is one of the companies that's been instrumental in making CD-ROM drives popular, making both internal and external drives available for several years. That's not surprising, because it was largely responsible for developing both the CD-ROM and audio standards. I have to hand it to Philips for acknowledging that CD-ROM players are used both for business and pleasure, and for building a player that bridges the best of both worlds. My only complaint: Philips could have come up with a better name. CDD461RS doesn't exactly roll off the tongue. ■

—Stan Miastkowski

THE FACTS

Magnavox CDD461RS
$549

System requirements:
IBM PC, AT, PS/2, or compatible with a free 8-bit ISA expansion slot.

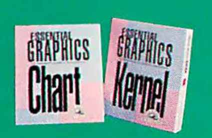
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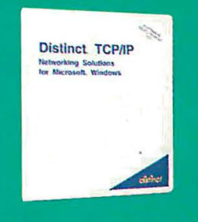


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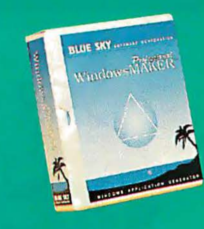


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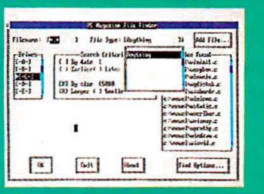
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* All prices subject to change without notice.

Circle 92 on Inquiry Card.

A Sandwich to Go

This sandwich-style 386SX notebook includes a 360-dpi bubble-jet portable printer. The system opens like a typical clamshell case, with the keyboard in front of the display; another section opens behind the display and holds the printer. Preconnected cables eliminate the need to hook up components.

With a 20-MHz CPU and 4 MB of RAM (expandable to 6 MB), the unit has a 20-MB hard drive that you can upgrade to 40 or 60 MB. Other features include a backlit 640- by 480-pixel VGA display, a coprocessor socket, an internal modem slot, a 3½-inch floppy drive, two serial ports, one parallel port, and a port for an external monitor.

Price: $3250.

Contact: BEC Computer Corp., 22 Yearling Court, Rockville, MD 20850, (301) 294-2152.

Circle 1271 on Inquiry Card.



BEC Computer's sandwich-style 386SX notebook computer.

Jupiter Brings Power to Your Computing

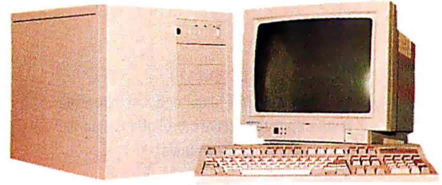
The Jupiter Class Evolution (JCE) systems in Epic Microsystems' Enhanced Machine Series (EMS) computers support up to 128 MB of on-board RAM and up to 512 KB of cache. The systems use a passive 32-bit EISA motherboard that accepts a processor card in a proprietary slot, leaving seven 32-bit slots open.

The basic JCE 386/40 desktop has 8 MB of RAM, 3½- and 5¼-inch floppy drives, a 160-MB IDE hard drive, an EMS IDE controller with 1 MB of cache, a 1-MB VGA card, one parallel and two serial ports, and a 14-inch VGA color monitor. The JCE 386/40 workstation has 16 MB of RAM, a 3½-inch floppy drive, a 3½-inch 500-MB SCSI hard drive, an EMS SCSI controller with 4 MB of cache, a 1-MB/768-KB video RAM 60-MHz Graphics Xcellerator, one serial and two parallel ports, and a 14-inch VGA color monitor. DOS 5.0, Qualitas 386Max, Windows 3.0, and a Microsoft Mouse are standard with both models.

Price: Desktop model starts at $6219; workstation starts at $8949.

Contact: Epic Microsystems, Inc., 3R Tigertail Cir., Derry, NH 03038, (603) 432-6079; fax (603) 437-6893.

Circle 1272 on Inquiry Card.



The Jupiter Class Evolution system.

Scalable Multiprocessor System

The first of Micronics' Mpro scalable multiprocessor computer systems, the SMP-2000 and SMP-4000 are designed for use with SCO Unix MPX and Banyan Vines SMP. The 486-based system also works with DOS, Windows, NetWare, Unix, and OS/2.

The SMP-2000 runs at 33 or 50 MHz and is upgradable to two CPUs—each with 256 KB of write-back cache—via a second plug-in CPU board. Its 8 MB of on-board RAM is expandable to 128 MB. The system uses 64-bit buses, includes six 32-bit EISA expansion slots and two CPU/memory slots, and supports bus-mastering hardware. It includes four half-height bays, a 3½-inch floppy drive, a VGA video card, and one parallel and two serial ports.

The initial version of the SMP-4000 system has up to four 33-MHz 486 CPUs. In addition to features of the SMP-2000, it supports up to 256 MB of system RAM and has eight EISA expansion and six CPU/memory card slots. The unit comes in a tower case with nine half-height bays and a 3½-inch floppy drive.

Price: Starts at under $10,000 for each system.

Contact: Micronics Computers, Inc., 232 East Warren Ave., Fremont, CA 94539, (510) 651-2300; fax (510) 651-5612.

Circle 1273 on Inquiry Card.

Cellular, Mobile, and Modular

The Grid Cellular Notebook System combines a 386SX-based Grid 1750 notebook computer with PowerTek's model CMI 990 cellular data transmission package. The two units incorporate everything necessary for cellular mobile computing, forming a package that weighs 11 pounds, including batteries.

The system's modular design lets you go on the road with the 6-pound Grid 1750, and then, when you're back in your car or motel room, you can link up the PowerTec CMI to transmit or receive data. The system uses a 9600-bps Microcom Micro-Modem, a Fujitsu transceiver, an intelligent adapter, and a PowerTec cellular interface. It has 1 MB of RAM, a 3½-inch floppy drive, a 60-MB hard drive, a VGA backlit LCD, an autosensing power adapter, and DOS 5.01.

Price: $5871.

Contact: Grid Systems Corp., 47211 Lakeview Blvd., Fremont, CA 94537, (510) 656-4700.

Circle 1274 on Inquiry Card.

Multipurpose Portable Printer

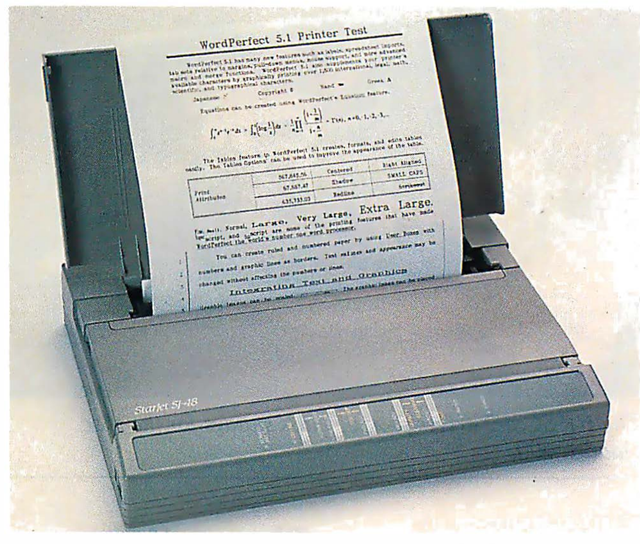
With 24 KB of memory and an optional nickel-cadmium battery pack, the 4-pound StarJet SJ-48 multi-purpose ink-jet printer prints up to 40 pages without a recharge. Its 64-nozzle print head maintains a 45-dB sound level while it prints with laser quality on a variety of paper.

The SJ-48 has four resident bit-mapped fonts, two 1.2-MB floppy disks of utilities and fonts for desktop publishing, and a driver for Windows 3.0. Able to print graphics at 360 dpi, the SJ-48 prints more than 6½ text pages per minute at 20 cpi. The printer also has a quarter-size mode that lets it print up to 273 characters per line in 20-cpi mode.

Price: $499; optional battery pack, $50.

Contact: Star Micronics America, Inc., 420 Lexington Ave., Suite 2702, New York, NY 10170, (212) 986-6770; fax (212) 286-9063.

Circle 1275 on Inquiry Card.



You get printing flexibility with the StarJet SJ-48.

Speedy Optical Data Storage

Sumo's SS630 rewritable optical data storage subsystem stores 600 MB of formatted data per removable data cartridge and offers unlimited data storage. The system operates at average seek times of 28 ms and average access times as low as 37 ms. It supports data transfer rates as high as 1 MBps.

The SS630 stores data on a 5¼-inch ISO-compatible removable cartridge using magneto-optic recording techniques. Equipped with a SCSI-2 connection, it is easily integrated with IBM, DEC, Sun Microsystems, and Macintosh platforms. The unit includes all software drivers and has automatic on-line formatting.

Price: $4295.

Contact: Sumo Systems, 1580 Old Oakland Rd., S-C103, San Jose, CA 95131, (408) 453-5744; fax (408) 453-5821.

Circle 1276 on Inquiry Card.

TouchMonitors in Two Styles

The GoldStar 1430Plus TouchMonitor, a fully integrated plug-and-play 14-inch VGA touchscreen, is available with your choice of a serial or PC-Bus controller. You also have a choice of an IntelliTouch or AccuTouch screen.

The pure glass IntelliTouch touchscreen uses Surface Acoustic Wave technology in its completely transparent panel; the waves in the glass are absorbed by a finger or other soft pointing object. The panel, which senses touch location as well as touch pressure, can be mounted on CRT or flat-panel displays.

The AccuTouch screen incorporates resistive technology, which uses a transparent polyester coversheet over a glass panel. The layers are separated by tiny transparent dots, each less than 1/1000 inch thick. The facing surfaces of the layers have a clear conductive coating; a light touch registers the touch location by pushing the layers together.

Price: GoldStar AccuTouch 1430Plus TouchMonitor with PC-Bus card controller, $1160; GoldStar IntelliTouch TouchMonitor with PC-Bus card controller, $1280.

Contact: Elographics, Inc., 105 Randolph Rd., Oak Ridge, TN 37830, (615) 482-4100; fax (615) 482-4943.

Circle 1277 on Inquiry Card.

CD-ROM Drive Takes to the Road

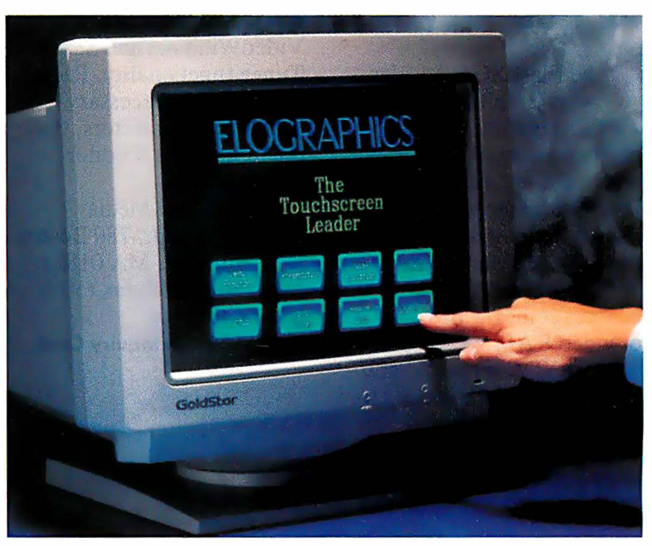
The portable TXM-3301P CD-ROM drive, based on Toshiba's XM-3300 Series drive, has a 325-ms average access time and a sealed drive enclosure that excludes contaminants.

The TXM-3301P weighs 3.8 pounds and has an optional battery pack that provides up to 4 hours of operation. The drive features a low-battery detector and indicator and includes an AC power adapter. An optional parallel-to-SCSI cable connects the drive to laptop and notebook computers.

Price: $999.

Contact: Toshiba America Information Systems, Inc., Disk Products Division, 9740 Irvine Blvd., Irvine, CA 92718, (714) 583-3000.

Circle 1278 on Inquiry Card.



The GoldStar 1430Plus TouchMonitor.

SCSI-2 Drives for the Quadra 900

A family of Hewlett-Packard SCSI-2 internal drives for Apple's Mac Quadra 900 are available in 5¼- and 3½-inch sizes. The drives are targeted for use with CAD/CAM, graphics, and other high-capacity storage environments.

The 3½-inch drive offers 422 MB of formatted capacity with an average seek time of 12.6 ms and an asynchronous burst transfer rate of 1.5 MBps. The 5¼-inch drives have formatted capacities of 1.355 and 1.070 gigabytes and 677 MBps. Their seek time is 13.5 ms, and they have an asynchronous burst transfer rate of up to 1.5 MBps. All drives include HP's Formatter software with full driver support, cables, and trays.
Price: $2695 to $5095.
Contact: Hewlett-Packard Co. Inquiries, 19310 Pruneridge Ave., Cupertino, CA 95014, (800) 752-0900.
Circle 1279 on Inquiry Card.



The HP SCSI-2 drives provide mass storage for the Mac Quadra 900.

XGA Board for PCs

The FlashXGA Accelerated Graphics Adapter for PCs combines a high-performance CRT controller with a bus-mastering graphics coprocessor to create a display adapter similar to the XGA (Extended Graphics Array) for the PS/2. The adapter comes with 1 MB of video RAM.

FlashXGA supports most PC display resolutions up to 1024 by 768 pixels noninterlaced with 256 simultaneous colors. It has a refresh rate programmable to 72 Hz and supports the IBM XGA 16-bit color format for direct display of 65,536 simultaneous colors, as well as the 15-bit Targa format for 32,768 simultaneous colors at up to 800-by 600-pixel resolution.
Price: $649.
Contact: Video Dynamics, Inc., 1550 Bryant St., San Francisco, CA 94103, (800) 243-3527 or (415) 863-3023.
Circle 1280 on Inquiry Card.

TV in a Window

TV-VideoWindows, a single-slot, full-length board for displaying broadcast or cable TV within Windows, integrates Super VideoWindows and Super Tuner functionality. Packaged with all necessary cables and connectors, the board includes VEditor.
Price: $1195.
Contact: New Media Graphics Corp., 780 Boston Rd., Billerica, MA 01821, (508) 663-0666; fax (508) 663-6678.
Circle 1281 on Inquiry Card.

Diagnostic Test Card Fits in a Pocket

The PocketPost diagnostic test card for ISA and EISA computers plugs into any available expansion slot and quickly shows why your computer won't boot. Landmark's PC Certify diagnostic test software, bundled with the card, helps to isolate problems on systems that boot but aren't running smoothly. PC Certify requires 128 KB of memory and can run in remote mode.

PocketPost conducts three major diagnostic tests. For the first, a digital display shows power-on self test codes issued by the BIOS when you switch on the computer's power. For the second test, a built-in voltmeter with five LEDs shows when the proper power level is on and within 90 percent of rated value. In the third test, an LED and jumpers show whether nine vital bus signals are toggling properly.
Price: $249.
Contact: Data Depot, 1710 Drew St., Clearwater, FL 34615, (800) 275-1913 or (813) 446-3402; fax (813) 443-4377.
Circle 1282 on Inquiry Card.

Piggyback Card Surrounds You with Sound

The Surround Sound Module from Ad Lib is a piggyback card that snaps onto the Ad Lib Gold card to give you sound enhancements ranging from stereo depth simulation to artificial reverb and echo. The module is compatible with all applications written with Ad Lib sound support, automatically enhancing the application you're using when you choose an effect from Ad Lib's selection.
Price: $89.95.
Contact: Ad Lib, Inc., 220 Grande-Allée East, Suite 850, Quebec, Canada G1R 2J1, (800) 463-2686 or (418) 529-9676; fax (418) 529-1159.
Circle 1283 on Inquiry Card.

Accelerate Graphics in Windows 3.0

The FlickerFree WindowsVGA 8800 graphics board with Safescan accelerates Windows 3.0 graphics software. With a refresh rate of 70 Hz, the board's Safescan feature eliminates the black border at the edge of your screen, letting you overscan and have 100 percent use of your screen. Other features include resolutions of up to 1280 by 968 pixels, 256 colors, 1 MB of memory, and a GUI accelerator. Genoa says the board's processing speeds are up to 30 times faster than Super VGA standards.
Price: $495.
Contact: Genoa Systems Corp., 75 East Trimble Rd., San Jose, CA 95131, (408) 432-9090; fax (408) 434-0997.
Circle 1284 on Inquiry Card.

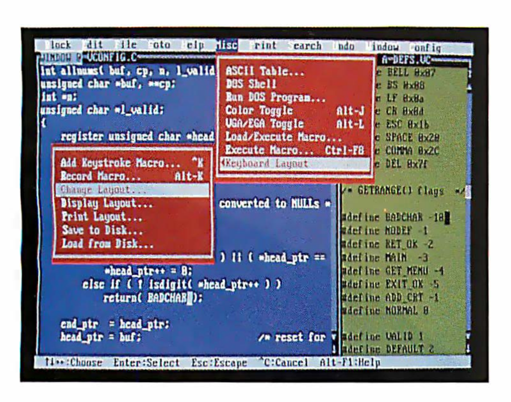
The new multi-mode VEDIT PLUS is the only text editor you will ever need!

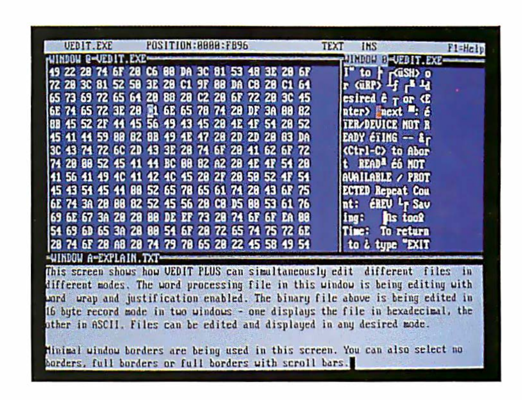
The most powerful text editor for program development and text processing

- **Drop-down menus, mouse support**
- **Columnar blocks, regular expressions, undo**
- **Also VEDIT for $69, VEDIT Jr. for $29**

The fastest text editor for mainframe, CD ROM and other huge files

- **Edit up to 2 Gigabyte text, binary, mainframe files**
- **Edit in ASCII, EBCDIC or Hexadecimal**
- **Emulate Wordstar, Word Perfect, Brief, vi, others**





The new VEDIT PLUS is today's finest programmer's editor. Small (80K) and lightning fast, it is written entirely in assembly language. VEDIT PLUS is the only programmer's editor that can edit *any* text or binary file you will ever encounter.

Incredibly, VEDIT is over 20 times faster than other editors on just a 3 megabyte file. When editing multi-megabyte files, only VEDIT has the speed to get the job done.

Benchmarks in 3 Meg File	VEDIT	Brief	Sage
Save and continue	52 sec	3:52 min	1:47 min
Load, modify, save, exit	21 sec	49 sec	1:38 min
Block-column copy (40x200)	2 sec	30 sec	2 sec
Delete one column in file	9:58 min	1:50 hour	1:03 hour
60,000 search & replace	3:18min	1:44 hour	1:32 hour

The extensive compiler support runs popular compilers and also your favorite linkers, debuggers and Make from within VEDIT. It even integrates tools from different vendors. When shelling to DOS, VEDIT swaps itself and TSRs out of memory, giving you as much as 620K of available memory for compiling the biggest programs. Only VEDIT gives you the advantages of a powerful editor with the convenience of an integrated environment.

VEDIT PLUS has every advanced feature you might expect. Simultaneously edit numerous files, split the screen into windows, search/replace with regular expressions. Automatic indent, block indent, parentheses matching and block operations by character, line, file or column speed program development. Word wrap, paragraph formatting, justification, centering and many printing options are ideal for text processing.

VEDIT PLUS has the most powerful macro programming language of any editor. It eliminates repetitive editing tasks and lets you create your own editing functions. It includes testing, branching, looping, user prompts, keyboard input, string and numeric variables, complete control over windows plus access to hardware interrupts, memory and I/O ports. Source level debugging helps you develop new macros quickly and easily.

Until now, few PC text editors could even begin to handle huge mainframe, CD ROM, postscript, plotter output and other multi-megabyte files. The new VEDIT PLUS, with its unique virtual memory management, handles them all effortlessly.

Edit in ASCII, EBCDIC or Hexadecimal modes, or split the screen for any combination of modes. File modes support DOS text, UNIX text, binary and many fixed length record formats.





An intuitive user interface with drop down menus, hot keys, mouse support, optional scroll bars, context sensitive help, point and shoot file selection, 1000 level undo and unlimited keystroke macros make VEDIT PLUS easy to use, easy to learn. And it can emulate the keystrokes of almost any editor you already know.

Everything in VEDIT PLUS is configurable. The keyboard layout, the screen colors, the way control characters, long lines and window borders are displayed, and much more, is all configured with easy to use menus.

Confidently order your copy of VEDIT PLUS today; it comes with a 30 day money-back guarantee. VEDIT has been the choice of 100,000 programmers, writers and engineers since 1980.

VEDIT PLUS - DOS single user license: $185; DOS network 5 user license: $295; UNIX/XENIX, QNX, FlexOS/IBM 4680 single CPU license: $285. Site license pricing is available.

24-Hour Bulletin Board

A fully functional demo version of VEDIT PLUS and a shareware version of VEDIT Jr. are available on our BBS at 1-313-996-1304.

Toll Free: 1-800-45-VEDIT (1-800-458-3348)
Telephone: (313) 996-1300, Fax: (313) 996-1308
Mail: P.O. Box 1586, Ann Arbor, MI 48106

Greenview Data

Circle 37 on Inquiry Card.

Perhaps the most ama
PC is that it can



At NEC, we put as much emphasis on affordability as we do on upgradability. Add a Pinwriter® P3200 and a MultiSync 3FGx to your Image Series PC and you can do high-level computing without paying a high price.

Anyone who thinks you can't do anything with a quarter these days obviously hasn't seen NEC's new PowerMate® Image™ Series SX/16i and SX/20vi PC's. With their tool-less design, all it takes to open them is the quick turn of a quarter. Then you can customize your computer yourself as your needs change. For instance, you can increase your system or video memory by just plugging in chips. And storage devices easily snap into place, too. We've even made it easier to upgrade your system *in* the future. Simply send us your old Image motherboard and we'll credit





zing thing about our $1,199* be upgraded with a quarter.

its value towards a new one.** And we don't just give you a faster CPU, either. We can give you more memory, cache and video, as well. But that's not all. There's also space for additional drives. So you have room for new technologies like CD-ROM. And like the rest of our Image Series PC's, the SX/16i and SX/20vi come with plugs and jacks that make them multimedia ready. There's ImageSync™ technology for flicker-free graphics when used with our new MultiSync® FG™ monitors. FLASH ROM for upgrading or enhancing your BIOS via diskette. And pre-loaded MS-DOS® 5.0, Windows® and PFS: Window Works.™ For more information, call 1-800-NEC-INFO, or NEC FastFacts at 1-800-366-0476, #IMAGE (46243). After all, a computer isn't worth a dime unless you can upgrade it with a quarter.

Because ↑ is the way you want to go.



Intel is a registered trademark and the Intel Inside logo is a trademark of Intel Corp. © 1991 NEC Technologies, Inc. *Manufacturer's suggested retail price for the PowerMate SX/16i; MSRP for SX/20vi is $1,349.00. **See your dealer for complete details.

Circle 109 on Inquiry Card.

Communicate Fast with MNP-10 ACE

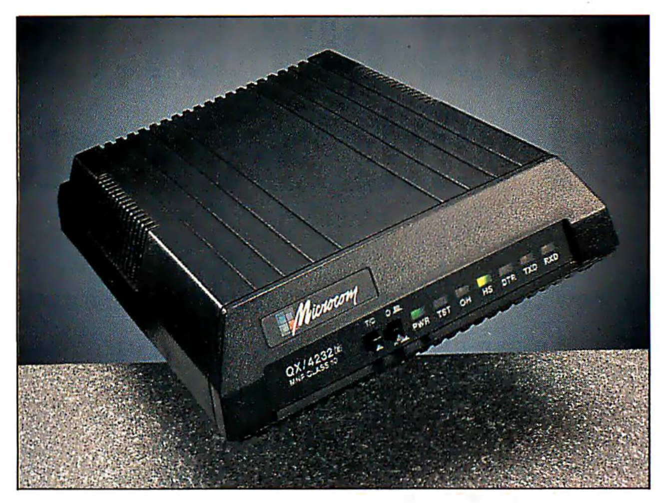
The QX/4232bis, a V.32bis modem, uses MNP 10 with Adverse Channel Enhancements (ACE) for communication between computers on dial-up and leased lines. According to Microcom, MNP 10 data transmission enables error-free interactive data transfer over noisy telephone lines.

MNP 10, which provides the reliability to maintain the high speed of V.32bis transmissions, automatically decreases the QX/4232bis transmission rate to establish a stable connection when interference increases. As link quality returns to normal, the modem automatically returns to optimal speed.

Price: $999; bundled with CarbonCopy Plus or Relay Gold, $1099.

Contact: Microcom, Inc., 500 River Ridge Dr., Norwood, MA 02062, (617) 551-1000; fax (617) 551-1007.

Circle 1285 on Inquiry Card.



Microcom's QX/4232bis modem uses MNP level 10.

Smooth Operator Uses Windows

Smooth Operator 3.0 adds a GUI enhancement to its previous release, making it compatible with Windows 3.0. With new user-friendly help screens and the capability to run on most LANs, Smooth Operator 3.0 offers the flexibility to develop application environments and technologies through an open modular approach. FaxRetrieval, an optional fax-on-demand module, is available.

Price: Starts at $22.95; FaxRetrieval, $17.50.

Contact: Compass Technology, Inc., Live Oak Office Center, 2201 Cantu Court, Suite 116, Sarasota, FL 34232, (813) 371-8000; fax (813) 377-5600.

Circle 1286 on Inquiry Card.

Printer Flexibility on Your LAN

A flexible network-printer interface for Hewlett-Packard LaserJet Series II, IID, III, and IIID printers, EtherFlex allows direct printer connection anywhere on a LAN. It provides Apple EtherTalk and NetWare support on a single card that installs in the optional I/O slot of the LaserJet. You choose the protocol you want by setting a switch, which you reconfigure when you want to use the other protocol. The inclusion of BNC and 10Base-T Ethernet connectors gives you LAN connection flexibility.

Price: $695.

Contact: Extended Systems, 6123 North Meeker Ave., Boise, ID 83704, (800) 235-7576 or (208) 322-7575; fax (208) 377-1906.

Circle 1287 on Inquiry Card.

DOS and Windows in a Fax Server

Version 2.0 of the LanFax Redirector peer-to-peer fax server combines compatibility with DOS and Windows in one package. With a new user interface for fax management, LanFax Redirector now has DDE and DDL support for Windows applications, HP PCL-5 support for DOS applications, binary file transfer, and multiline support.

Ugraded server technology supports up to eight fax cards per server, HP PCL-5 to Group 3 conversion at the server, EMS support, and dynamic log-in. In addition to operating systems previously supported, 2.0 supports OS/2 LanServer, LANtastic, 10Net, and DECnet 4.0. A new fax modem supported is LaserJet Fax.

Price: Starts at $995.

Contact: Alcom Corp., 1616 North Shoreline Blvd., Mountain View, CA 94043, (415) 694-7000; fax (415) 694-7070.

Circle 1288 on Inquiry Card.

Share a Modem on the LAN

With CO/Session ACS, any network user can access any modem to send or receive communications. Working in the background on the PC to which the modem is connected, CO/Session ACS is compatible with LAN communications software that supports an Interrupt 14 interface.

CO/Session ACS's low network memory requirements mean that PCs with modems attached to them for sharing require only 9 KB of memory; PCs needing access to a modem attached to another PC require only 6 KB of memory. No special hardware or communications cards are required.

Price: Two-modem version, $295; four-modem version, $590.

Contact: Triton Technologies, Inc., 200 Middlesex Tnpk., Iselin, NJ 08830, (908) 855-9440; fax (908) 855-9608.

Circle 1289 on Inquiry Card.

Caching Controllers for Multitasking

The hyperStore easyCache and easyCache Pro caching disk controllers let you configure a PC-based workstation or network server with up to 12.6 gigabytes of mass storage. Each controller is based on a 16-bit Z280 microprocesor to create a self-contained parallel computer, freeing the PC's CPU for other tasks.

Price: easyCache, $585 to $635; easyCache Pro, $725 to $775.

Contact: Perceptive Solutions, Inc., 2700 Flora St., Dallas, TX 75201, (214) 954-1774; fax (214) 953-1774.

Circle 1290 on Inquiry Card.

One more great reason.

Three great reasons to buy dBASE now:

✓ 1. Borland's commitment to dBASE

✓ 2. Borland's commitment to technology

✓ 3. Borland's commitment to customers

Now that it's from Borland, you can buy dBASE® with total confidence. Simply stated, Borland is fully committed to delivering more power, more flexibility and better support to the whole dBASE community.

Borland advances the dBASE standard.
Because Borland is the leader in object-oriented technology, today's dBASE buyer will get more features and new dBASE releases in less time – such as SQL server links, event handling, object-oriented extensions to the dBASE language and compilers that generate fast, tight code.

In addition, dBASE users will be able to effortlessly integrate data from the desktop to the mainframe with our InterBase server.

Borland support means greater customer satisfaction.
Now that dBASE is from Borland, dBASE customers are assured of world class support. In fact, J.D. Power and Associates ranks Borland "Best Application Software in Customer Satisfaction, in small to medium-size and large businesses."



Borland, your database partner in the 90's.
When it comes to technological innovation and customer satisfaction, Borland leads the way. Borland is committed to advancing the dBASE standard on multiple platforms – DOS, Windows, VAX VMS, Sun, UNIX and Macintosh.

A special offer when you buy dBASE now.
Buy dBASE from any dealer between November 1, 1991 and January 31, 1992, and get a $100 manufacturers rebate. (See the coupon accompanying this ad for details.)

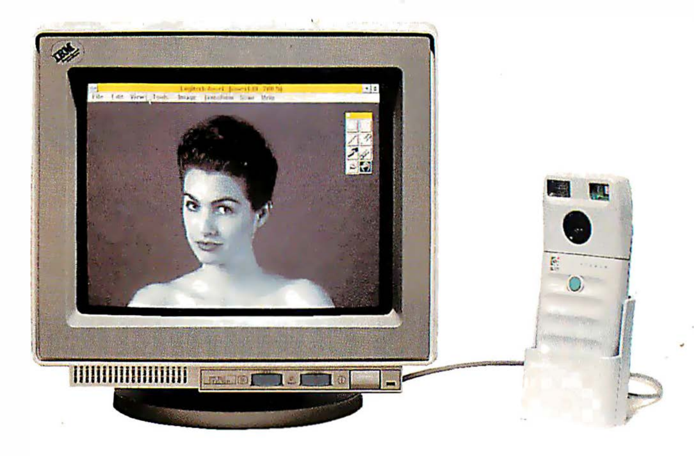
See your dealer today or call 1-800-568-9092 now for rebate information.

BORLAND

Software Craftsmanship

CODE MP02

Circle 25 on Inquiry Card (RESELLERS: 26).



New FotoMan.™ The portable affordable camera for your computer.

It's positively amazing. Now you don't have to wait around to get your photos developed. Or pay for film. Or prints. New FotoMan takes great shots, displays super sharp digitized pictures on your PC in a flash, and comes with all sorts of creative image editing tools.

Take it anywhere.

Powered by built-in rechargeable batteries, pocket-sized FotoMan can shoot 32 pictures in a session. It also comes with a filter for great shots in the great outdoors. And FotoMan's single button operation, automatic flash, and infinite field of focus make it a snap to use—anywhere.

A darkroom in your PC.

After your photo session, simply plug FotoMan into the serial port of your desktop or portable IBM PC (or compatible) and transfer your images in just seconds. You don't even need a digitizing board. Then preview and select the images you want to save.

FotoMan's Windows™ based image editing software—FotoTouch™—displays images in 256 shades of gray, and makes editing and retouching fast and fun: crop backgrounds, change sizes, adjust contrast and brightness, even create special effects. You can use your perfected pictures in any application. And a file compression feature saves them in a minimum of storage space.

FotoMan comes with everything you'll need, plus something you probably won't: lifetime service and support. And at $799 FotoMan costs hundreds less than any other digital camera. We're positive you'll be impressed. For more information call toll free:

800-231-7717 ext. 345.



Tools That Power The Desktop.

Circle 90 on Inquiry Card (RESELLERS: 91).

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WITHOUT ALL THE NEGATIVES.

FOTOMAN

LOGITECH









Soft-ICE/W Lets You Debug from Within Windows

Soft-ICE, the 386 debugger that performs insecticidal tasks usually associated with in-circuit emulators, has made the transition from real-mode to protected-mode application debugging. The first debugger for Windows 3.1, Soft-ICE/W lets you debug Windows programs at the system or application level, Nu-Mega says.

You can use Soft-ICE/W to debug virtual device drivers, DOS virtual machines, device drivers, and applications from within Windows. The program features memory-range and memory-location breakpoints and a back-trace function.

Nu-Mega also offers CV1, which lets you run and display Microsoft's CodeView within a window without having to leave the Windows environment.

Price: Soft-ICE/W, $386; CV/1, $129.

Contact: Nu-Mega Technologies, Inc., P.O. Box 7780, Nashua, NH 03060, (603) 889-2386; fax (603) 889-1135.

Circle 1291 on Inquiry Card.

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0028:8007BB0F   RET
0028:8007BB10   CALL   [Set_PM_Exec_Mode]
0028:8007BB16   JMP    [Begin_Use_Locked_PM_Stack]
0028:8007BB1C   CALL   [Begin_Use_Locked_PM_Stack]
0028:8007BB22   JMP    [Set_V86_Exec_Mode]
0028:8007BB28   INT    20 VXDCall Simulate_Far_Ret
0028:8007BB2E   INT    20 VXDCall End_Use_Locked_PM_Stack
0028:8007BB34   INT    20 VXDCall Set_V86_Exec_Mode
0028:8007BB3A   OR     DWORD PTR [EDX],00000100
0028:8007BB40   JMP    8007BB9E
0028:8007BB42   CALL   [Simulate_Far_Ret]

VxD Name   Address    Length     Code   Data   Type
VMM        80001000   000163D0   0028   0030   LGRP
VMM        80200000   00002F1C   0028   0030   IGRP
LA20HMA    800173D0   000001B1   0028   0030   LGRP
LA20HMA    80202F1C   000009C4   0028   0030   IGRP
   Any Key To Continue, Esc To Cancel
```

Soft-ICE/W for Windows can debug programs at the system or application level. Here Soft-ICE/W is debugging a 32-bit Windows virtual device driver.

Clarion Goes Full Speed Ahead

Clarion has licensed the TopSpeed optimizing code generator from Jensen & Partners for use in the Professional Developer 3.0 database applications development tool. The internal computing speed of a Professional Developer 3.0 program is as much as 200 times faster than the same program created with FoxPro 2.0 or Clipper 5.0, Clarion says.

Professional Developer 3.0 also includes replaceable database drivers to let applications access a variety of databases. The package includes drivers for Btrieve, xBase, Paradox, and NetWare SQL. When used on a Novell network, the Btrieve driver automatically supports client-server architecture.

SQL drivers for Oracle, SQL Server, and other database drivers written by Clarion will be available through Clarionet, a toll-free information service that you can access for a $150 annual membership fee.

Clarion says Professional Developer 3.0 lets you enhance and customize vertical-market and accounting packages that use database engines supported by Clarion database drivers. Version 3.0's application generator includes visual templates and supports embedded source code.

Price: $995.

Contact: Clarion Software, 150 East Sample Rd., Pompano Beach, FL 33064, (800) 354-5444 or (305) 785-4555; fax (305) 946-1650.

Circle 1292 on Inquiry Card.

Stand-Alone dBase IV Compiler

A stand-alone compiler for the dBase IV language, Arago Quicksilver produces independent .EXE files from dBase source code. WordTech Systems will not charge any run-time or licensing fees for programs created using the new compiler.

The compiler includes an overlay linker and an automatic run-time environment configuration.

Price: $799.

Contact: WordTech Systems, Inc., 21 Altarinda Rd., Orinda, CA 94563, (510) 254-0900; fax (510) 254-0288.

Circle 1293 on Inquiry Card.

Complex Communications Library

Version 3.2 of the Greenleaf CommLib Level 2 C asynchronous communications library adds seven new drivers, bringing the total to 12. CommLib Level 2 offers support for XMODEM, YMODEM, ZMODEM, Kermit, and ASCII file transfer protocols, XON/XOFF, RTS/CTS (Request to Send/Clear to Send), DTR/DSR (Data Terminal Ready/Data Set Ready) handshaking, and first-in/first-out priority on 16550 universal asynchronous receiver/transmitters.

Greenleaf has also added drivers for the Phar Lap 286| DOS-Extender and Rational Systems' DOS 16M package. These drivers feature bimodal interrupt handlers, 16550 support, and hardware handshaking.

CommLib supports all the popular C and C++ compilers.

Price: $359.

Contact: Greenleaf Software, Inc., 16479 Dallas Pkwy., Suite 570, Dallas, TX 75248, (800) 523-9830 or (214) 248-2561; fax (214) 248-7830.

Circle 1294 on Inquiry Card.

A C Display Manager for DOS and OS/2

C-Display Manager 4.5, which provides support for screens, menus, and data handling, lets you create user interfaces in DOS and use them in OS/2 protected mode without change and vice versa.

Price: C-Display Manager (without source code), $119; C-Display Manager Advanced (library with source code), $199; C-Display Manager Professional (source code of utilities and design documentation), $599.

Contact: Sydetech System Development Technologies, Inc., 140-74 34th Ave., Suite 1C, Flushing, NY 11354, (718) 321-1572; fax (718) 321-9685.

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Faster Runtime

Run with ULSI Math Coprocessors

Applications Run Faster

The Math•Co™ 83C87 (DX) and 83S87 (SX) math coprocessors from ULSI Systems are complete double-CMOS, 1-micron technology chips. As a result of this superior architecture, the Math•Co coprocessors can perform floating-point mathematics in fewer clock cycles than needed by the standard Intel 80387.

Keeps on Running— Lifetime Warranty

ULSI Math•Co coprocessors have the industry's best Mean Time Between Failure (MTBF) rating—which is why we're able to offer the industry's only lifetime warranty.

Runs on Everything

Math•Co coprocessors are plug-in compatible with the IBM PC and PC clones. And they're 100% software compatible.

Runs Lean— Low Power Consumption

The Math•Co SX is ideally suited for laptop and portable IBM PC and PC compatible computers. It has a "sleep" mode feature which enables it to draw minimal power while in an idle state.

Operating Speed Availability

DX: 16, 20, 25, 33 and 40MHz
SX: 16, 20 and 25MHz



Instruction	Math•Co	Intel
Add	3	12
MPY	12	17
DIV	40	77
SQRT	37-41	97
REM	68-72	81

HEADQUARTERS

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Fax: 408-943-0106

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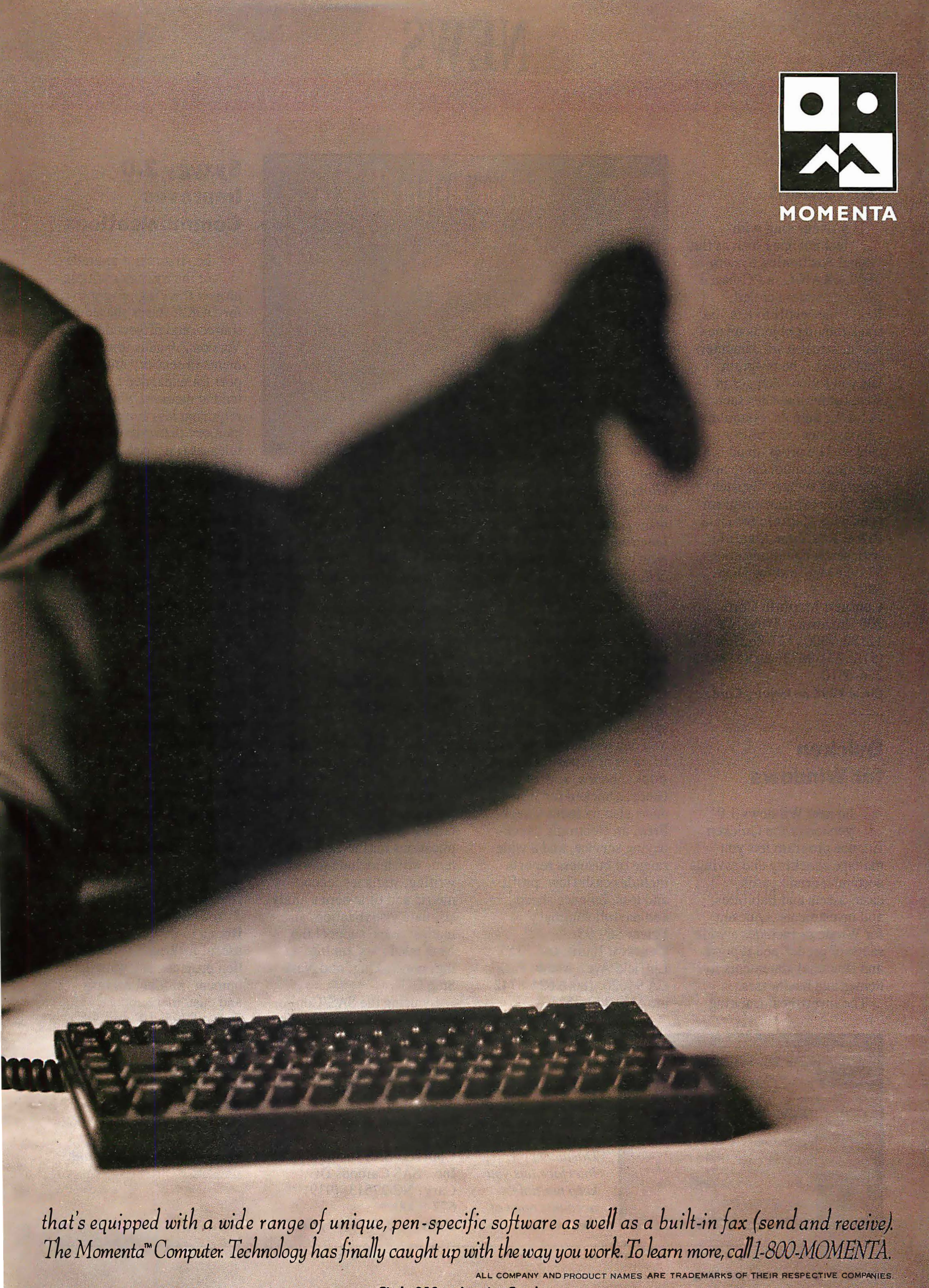
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Please do not attempt this on just any computer. *Now there's a computer that lets you choose how to work. You can write directly on the screen. Or use the keyboard. It's a fully-compatible 386 DOS®/Windows™ pentop computer*


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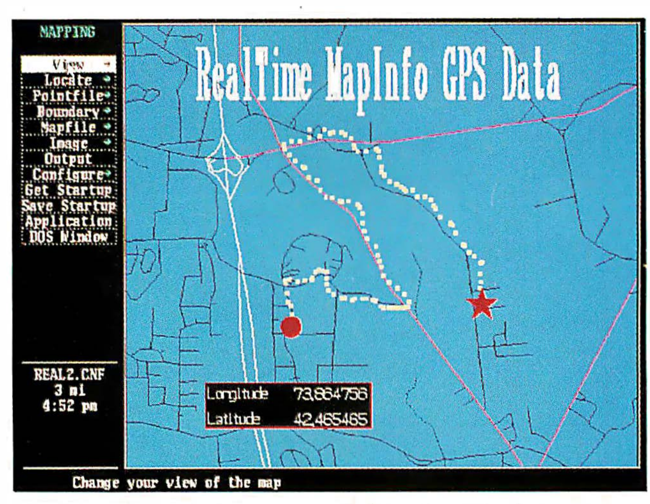
Map Your Movement

By integrating with technologies such as the Global Positioning System and LORAN C, a PC-based mapping system called RealTime MapInfo lets you track moving objects on detailed, street-level computerized maps. The program lets you follow changes in status at remote sites such as traffic signals, communications lines, and utility cables. The program adds a real-time component to applications such as dispatching. The real-time program runs with MapInfo for DOS.

Price: RealTime MapInfo with serial communications, $2495; MapInfo for DOS, $995.

Contact: MapInfo Corp., 200 Broadway, Troy, NY 12180, (800) 327-8627 or (518) 274-8673; fax (518) 274-0510.

Circle 1296 on Inquiry Card.



RealTime MapInfo integrates with technologies such as the Global Positioning System to track the exact location of moving objects on electronic street maps. A GPS processor takes readings from three or more satellites to determine longitude and latitude. Then a vehicle equipped with a GPS receiver sends its position to a receiving station via serial port, cellular phone, or hard connection for geographic display on RealTime MapInfo.

Quicken for Windows

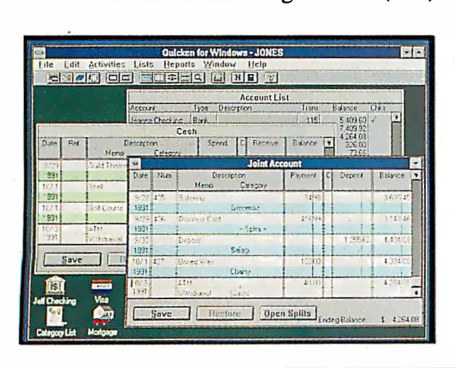
The new Windows 3.0 version of the Quicken finance program lets you manage checking and savings accounts, credit cards, cash, assets and liabilities, and investments. Quicken for Windows includes a wide range of predefined reports and financial statements for homes and businesses.

The investment tracking portion of Quicken keeps historical records of investment activities such as buys, sells, dividends, interest, fees, reinvestments, stock splits, and share prices. You can use it to manage certificates of deposit, IRAs, stocks, bonds, and mutual funds. Quicken for Windows also includes CheckFree, an electronic checkpaying service, and a wide range of business reports includes cash flow, profit and loss, balance sheets, and payroll summary.

Price: $69.95.

Contact: Intuit, Inc., 155 Linfield Ave., Menlo Park, CA 94026, (800) 624-8742 or (415) 322-0573.

Circle 1297 on Inquiry Card.



Quicken for Windows' support for Windows 3.0's Multiple Document Interface lets you keep multiple accounts open at the same time.

Statistics for the Next Computer

The SAS System of data access, management, analysis, and presentation applications is now available for all models in the Next family of workstations. Applications for the SAS System, which include report writing, statistics, econometric and time-series analysis, data visualization, and mathematics, support the Next machines' multitasking, networking, and NextStep GUI.

By using the SAS/Connect cooperative processing component, you can upload and download data or remotely submit SAS programs for mainframe processing.

Price: Annual fee starts at $825.

Contact: SAS Institute, Inc., SAS Campus Dr., Cary, NC 27513, (919) 677-8000.

Circle 1298 on Inquiry Card.

Syzygy 2.0 Improves Communications

The first major upgrade of the Syzygy multiple-project tracking program for DOS features shared resources and project data. Version 2.0 adds improvements in security and support for expanded and extended memory while requiring less conventional memory than did previous releases (i.e., 425 KB of RAM).

The company says that Syzygy 2.0's server-wide sharing of resources is accomplished through a single list of resources that contains Syzygy users, resources, and contacts, thus strengthening the program in the area of client-oriented project tracking.

To make it easier to transport Syzygy data between installations, version 2.0 adds a new interchange format called SyzIF that lets you export all or part of a Syzygy work map and share it with others, regardless of location.

Syzygy 2.0 offers three levels of security. Administrator, work-map administrator, and user levels offer access only to relevant functionality.

You can edit any task from a to-do list. Syzygy is useful for tracking publication projects, software development, product rollouts, and customer support.

Price: $395; 10-user edition, $1695; each additional five users, $695.

Contact: Syzygy Development, Inc., 5555 Triangle Pkwy., Suite 320, Norcross, GA 30092, (404) 662-5362; fax (404) 662-0908.

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NEW!! ASK ABOUT OUR NEW LOWER-PRICED INTEGRATED i386 & i486 MOTHERBOARDS

Free i860™ Processor and i860/APX Software!
By now, you've probably heard about our industry-first 4860™ MotherBoard that packs the power of the Intel 80486 CPU with the Intel 80860 RISC processor (i486™+ i860=4860).

What you haven't heard is that, for a limited time, when you buy a 4860 MotherBoard with 8MB of RAM, Hauppauge will give you an i860 RISC processor and the i860/APX operating system at no additional cost.

Why *give* you this capability? Because you'll enjoy a level of processor performance never before seen in a PC. Our bet is that you'll be so impressed, you'll come back for more!

A PC Revolution: In the PC environment, the 4860 is a 486-based MotherBoard with the new EISA I/O bus. It runs over 2 times faster than 386 computers and delivers mainframe power for applications including CAD, LAN and desktop publishing. This board is fully compatible with DOS, IBM's OS/2, Novell Netware and SCO UNIX. What's more, Hauppauge's 4860 supports up to 64 MBytes of memory *without* a RAM expansion board.

RISC-Y Business: The i860 processor is ideal in complex applications, performing up to 25 million floating-point operations per second. It adds to the power of the 486, so you can run rings around ordinary PCs.

By adapting Intel's APX (Attached Processor Executive) software to our 4860 MotherBoard, we've created a way to exploit the power of the i860 to give you *practical* multiprocessing. In fact, i860/APX provides a base for entirely new applications made possible by the advent of the i860 RISC processor.

Technical Features: 25 or 33MHZ 486/860 • 4 Mbytes of high speed RAM expandable to 64 Mbytes shared between i486 and i860 processors • Socket for optional Intel Turbo Cache 485™ and Weitek 4167 • 7 EISA I/O slots • 64-bit expansion slot for optional high-speed graphic frame buffer • 1 parallel, 2 serial ports and a built-in PS/2-style mouse port.

Enjoy a RISC-free investment. Our 4860 MotherBoard is designed with the world's highest performing microprocessors. So you can have the world's highest performing PCs and workstations.

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Fax: 516-434-3198
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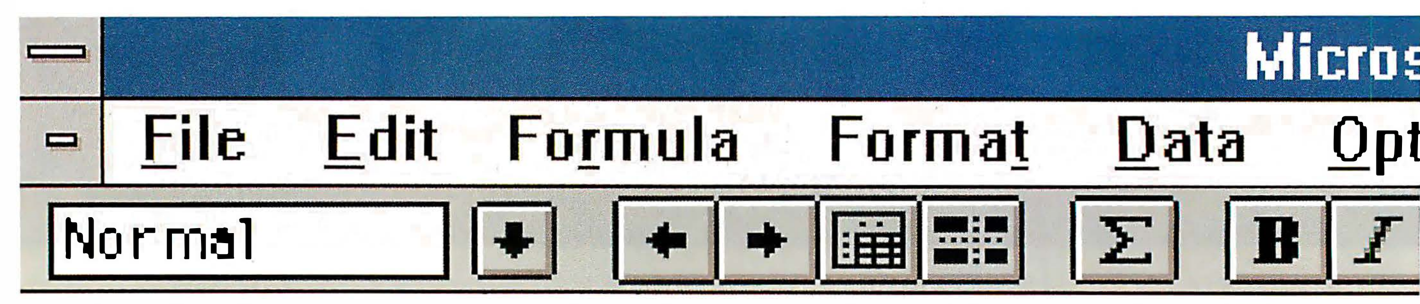


Available at your local computer dealer.

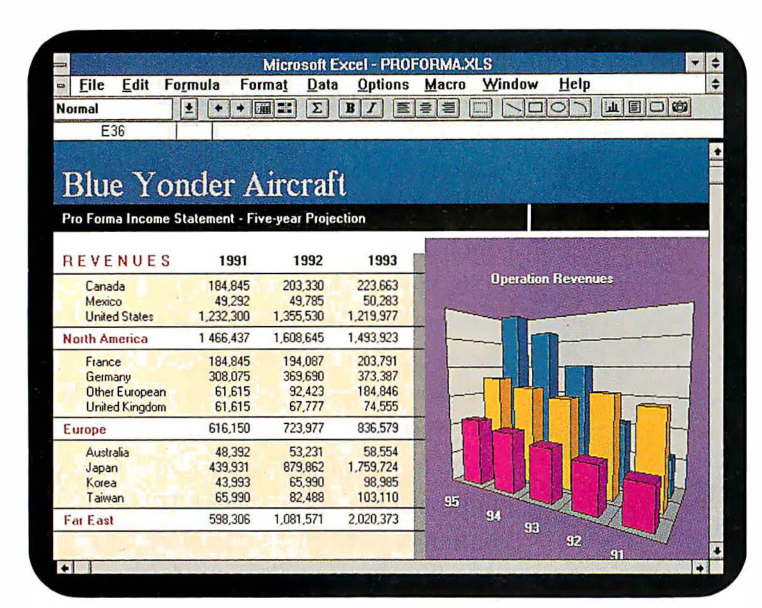
Trademarks: OS/2: IBM • Intel 386, i486, i860 and Turbo Cache 485™: Intel Corp. • DOS and Xenix: Microsoft Corp. • 4860, 4860 MotherBoard: Hauppauge

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The first sprea
you part of

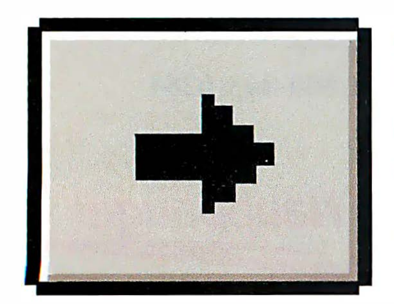


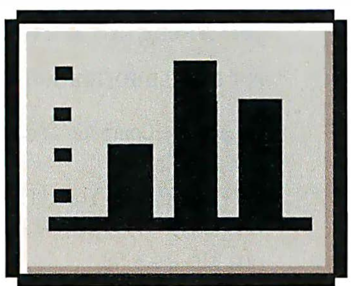
Quick, pick a function. That's how the Toolbar works: easy access to everyday features. For instance, to get a quick column total, simply hit the Autosum™ button, and there you go.



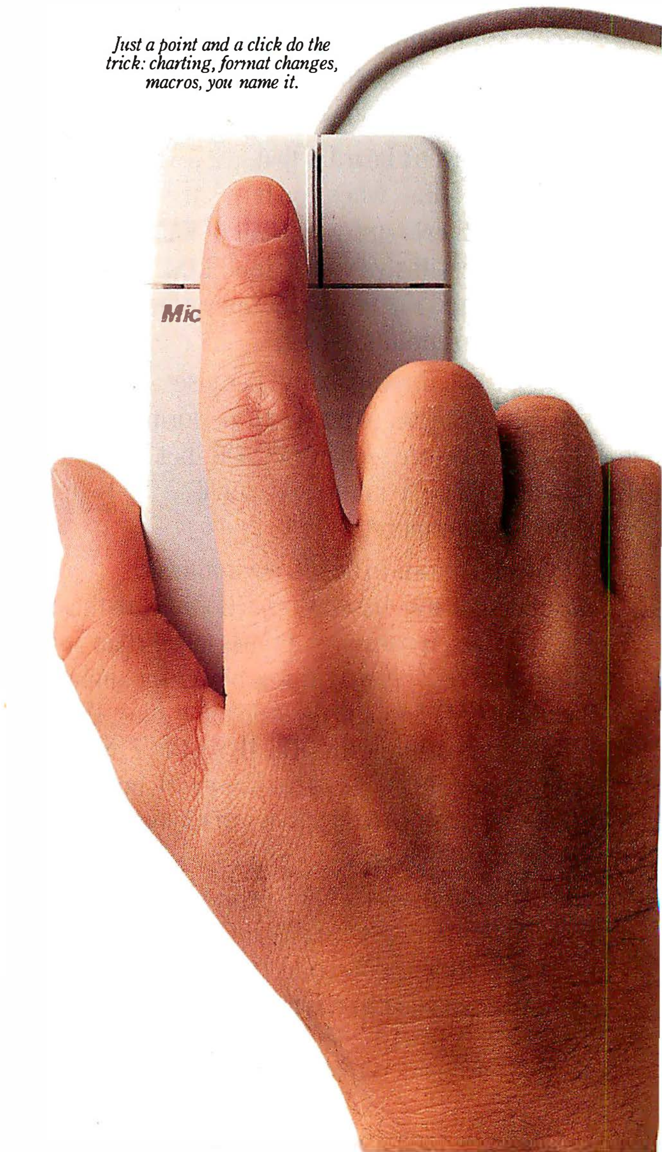
REVENUES	1991	1992	1993
Canada	184,845	203,330	223,663
Mexico	49,292	49,785	50,283
United States	1,232,300	1,355,530	1,219,977
North America	1 466,437	1,608,645	1,493,923
France	184,845	194,087	203,791
Germany	308,075	369,690	373,387
Other European	61,615	92,423	184,846
United Kingdom	61,615	67,777	74,555
Europe	616,150	723,977	836,579
Australia	48,392	53,231	58,554
Japan	439,931	879,862	1,759,724
Korea	43,993	65,990	98,985
Taiwan	65,990	82,488	103,110
Far East	598,306	1,081,571	2,020,373

Create an instant report: hit the outlining arrow to collapse or expand your worksheet, showing as much or as little detail as you need to. Then create a chart in one step, display it right on the worksheet, and voilà*—what you see on-screen is what you get at the printer.*

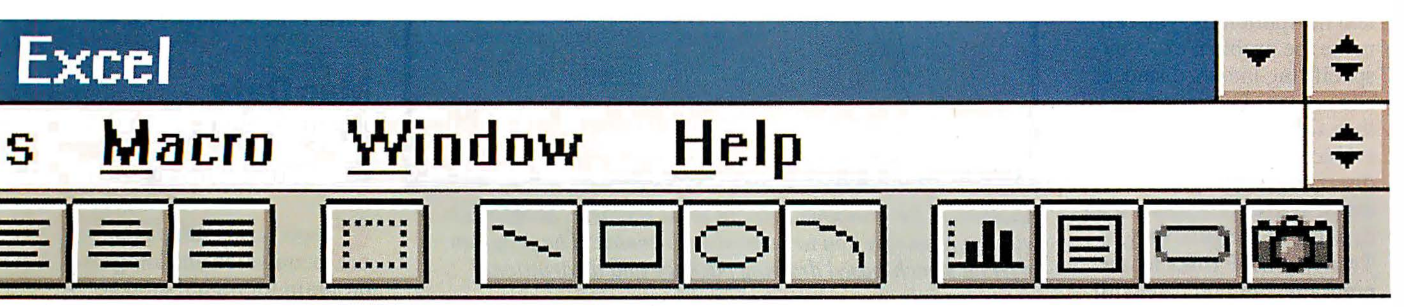


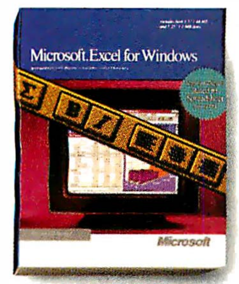


Just a point and a click do the trick: charting, format changes, macros, you name it.



dsheet to make the equation.





Microsoft Excel, the leading Windows spreadsheet.

There's one very important factor that most spreadsheets don't know how to handle: you.

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With plenty of easy-to-use features like the Toolbar,™ you may start to think of Microsoft Excel 3.0 as an extension of your thought process instead of a spreadsheet.

Which makes it easy for you to do some powerful things, such as consolidating up to 255 worksheets at a time, regardless of format or structure.

Or take Solver. It lets you start with a desired result and work backwards to find the variable you need.

It's also easy to share results with other Windows applications, like Microsoft Word for Windows. (Just what you'd expect from the people who pioneered the first Windows spreadsheet.)

And Microsoft Excel reads and writes Lotus® files. And converts 1-2-3® macros. And offers online help to guide you through your transition from Lotus to the friendliest spreadsheet ever seen on the personal computer.

Finally, consider that, even if you are using Lotus 1-2-3, you can upgrade to Microsoft Excel 3.0 for only $129.*

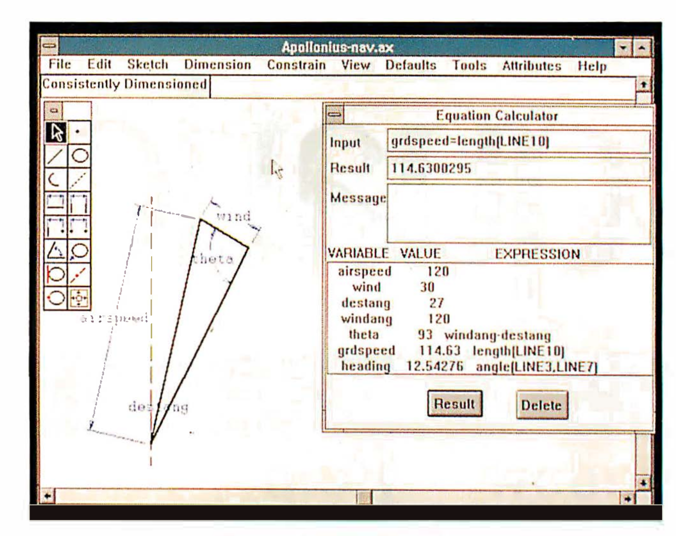
Just see your local reseller or give us a call at (800) 323-3577, Dept. W15.

Microsoft Excel and you. It all adds up.

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Solve Geometry Problems by Sketching

A new Windows-based geometry solver called Apollonius lets you describe and solve geometry problems by drawing them. Once you sketch out a problem in Apollonius, you can make the problem exact by specifying known distances and angles. The program will then solve the geometry problem by giving unknown distances, angles, and areas. It also provides a scale drawing of the geometry. Two-way DXF links let the program communicate with popular CAD programs.
Price: $98.
Contact: Saltire Software, P.O. Box 1565, Beaverton, OR 97075, (503) 642-1874; fax (503) 642-5705.
Circle 1300 on Inquiry Card.



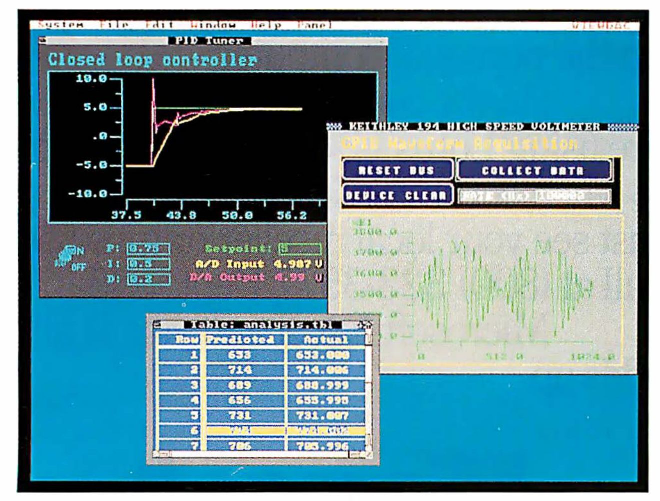
Apollonius for Windows 3.0 can solve geometry problems without requiring you to remember formulas. The program offers a sketch-based drawing package and a variational geometry solver.

Viewdac Adds GPIB, RS-232 Support

Viewdac, the data acquisition, analysis, and graphics program for 386- and 486-based PCs, can now communicate with general-purpose interface bus (GPIB) and RS-232 instruments. Viewdac 2.0 also adds an external language interface, Lotus 1-2-3 I/O, and graphics output to Hewlett-Packard Graphics Language and PostScript plotters and printers.

The GPIB IEEE 488 standard interface offers a way to connect peripherals to the PC through a 24-pin parallel connector. Version 2.0 lets you automate a range of monitoring, test, and experimental applications without programming.

Viewdac 2.0 can control up to 56 GPIB instruments at once. The new external language interface, which lets you import custom analysis routines into the system, supports C and assembly language.
Price: $2495.
Contact: Keithley Asyst Software Technologies, Inc., 100 Corporate Woods, Rochester, NY 14623, (800) 348-0033 or (716) 272-0070; fax (716) 272-0073.
Circle 1301 on Inquiry Card.



Viewdac 2.0, a data acquisition, analysis, and graphics program for 386- and 486-based PCs, integrates its features in a multitasking, window-based system.

Serial Line Analysis for the PC

A new version of DataScope, which transforms your PC into a passive or active RS-232 data- and signal-line monitor and protocol analyzer, lets you run up to four concurrent active displays in any window arrangement. Paladin says that version 2.0 can outperform expensive dedicated hardware line monitors while eliminating the guesswork in working with serial line transmissions and can collect up to 8 MB of data with microsecond time-stamp resolution.
Price: $249.
Contact: Paladin Software, Inc., 3945 Kenosha Ave., San Diego, CA 92117, (619) 490-0368; fax (619) 490-0177.
Circle 1302 on Inquiry Card.

Mac Data Analysis for Oscilloscopes

SuperScope/488, a data acquisition and analysis program for digital-storage oscilloscopes and black-box digitizers, offers a transparent interface between your instrument and the Mac. Using dialog boxes and a front panel that resembles that of an oscilloscope, you can configure the program to transfer data and measurements to the computer for display or processing.

To transfer data from the oscilloscope to the program, you open a channel from within the program. All acquisitions are sent to the program without requiring programming on your part.

SuperScope/488 supports instruments from companies such as Tektronix, Hewlett-Packard, IOtech, Nicolet, and LeCroy. In addition to supporting IEEE 488 instruments, the program supports the MacADIOS line of digitizing hardware.
Price: $990; 488 Instrumentation Library, $290.
Contact: GW Instruments, Inc., 35 Medford St., Somerville, MA 02143, (617) 625-4096; fax (617) 625-1322.
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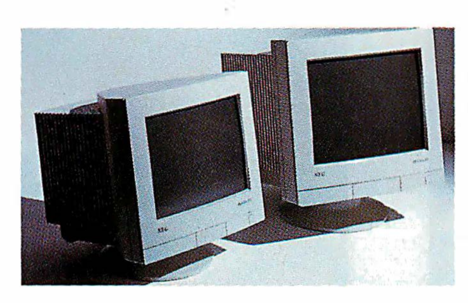
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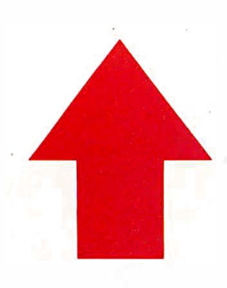
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* See your dealer for details.

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Are you missing the big picture? Do the little things just disappear? The new generation of MultiSync® monitors were designed to solve these problems with a larger, more readable display for windowing environments. Introducing the 15″ 4FG™ and the 17″ 5FG™ monitors. Larger screens combined with our FullScan™ capability provide edge-to-edge images in a much bigger display area. A high-contrast surface delivers exceptionally crisp text and graphics.



The new MultiSync 4FG and 5FG monitors. Images so big and sharp, you'll see more details in more detail.

Our innovations never stop. *The new MultiSync 4FG, 5FG, and 6FG monitors feature our AccuColor™ Control System. An amazing advance in computer monitors that lets you match on-screen colors to printer output, other monitors, and color reference systems such as Pantone®.*

Advanced screen technology gives you a flatter screen both horizontally and vertically, so images appear flat with less distortion at the edges. Higher refresh rates enable flicker-free images. Plus, on-board memory and digital controls store preset graphics modes and automatically size and center screen images. You can also adjust image size, position, on-screen color, and pin cushion.

Both monitors are compatible with MS-DOS based systems and the Mac II family and Quadra.™ The 4FG supports a range of video standards from VGA to 1024 x 768 (70 Hz) non-interlaced. The 5FG supports video standards from VGA to 1280 x 1024 (74 Hz) non-interlaced and many workstation modes.

The all-new 4FG and 5FG. So big, bright, and sharp it's easy to see their advantages.



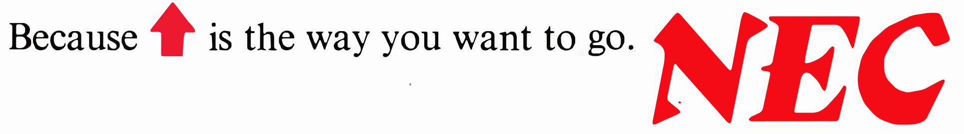
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MultiSync 4FG Monitor



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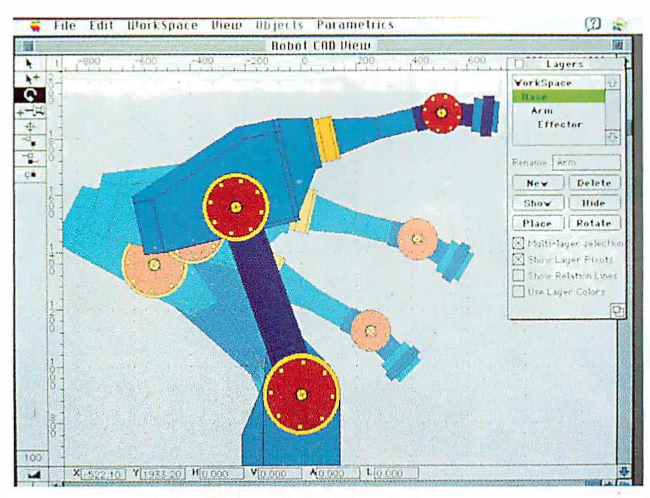
Circle 110 on Inquiry Card.

What-If Analysis for Claris CAD

Intended for use as a companion application to Claris CAD for the Mac, Vision Software's designPower lets you focus on the overall structure of your designs and experiment with different aspects of your work. designPower features relational layering, object linking, and parametric or what-if design tools. Geometric Resolver technology ensures that your design conforms to your predetermined specifications.

designPower includes a library of parametric symbols of doors and windows for use in architectural design settings. The program also features MacDraw II and DXF capabilities for integration with other Mac CAD and graphics programs.

Price: $399.
Contact: Vision Software, 3160 De La Cruz Blvd., Suite 104, Santa Clara, CA 95054, (800) 800-8476; fax (408) 748-9584.
Circle 1304 on Inquiry Card.



By moving or rotating designPower's relational layers, you can see how this robotic arm will move.

Create Gigantic Posters

Version 2.1 of S. H. Pierce's poster production program, PosterWorks, lets you create posters in sizes of up to 10,000 square feet. Using the Mac and any PostScript output device, you can use PosterWorks 2.1 to design tiled posters, displays, and billboards. The program lets you adjust imported color type, line-art objects, and scanned images. It also supports System 7.0, 32-bit addressing, and enhancements for AppleTalk devices.

PosterWorks 2.1 lets you import scanned images from Mac and DOS TIFF files and from Scitex CT files. The program features improved color and image control tools, including imported illustration-correction, type-correction, and image-saturation-control capabilities.

If you opt to have a professional large-format service bureau produce your hard copy, you'll appreciate PosterWorks' BureauFile export option. BureauFile contains the poster layout, imported elements, settings, and font listings in an editable format.

S. H. Pierce also offers a professional version of PosterWorks, designed for use by reprographic service bureaus in producing output on large-format devices. The Bureau Edition has all the features of PosterWorks 2.1 and takes advantage of the Mac's FPU for faster processing.

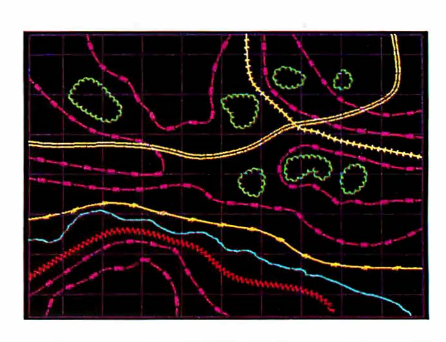
Price: PosterWorks 2.1, $295; Bureau Edition, $2995.
Contact: S. H. Pierce & Co., Suite 323, Building 600, 1 Kendall Sq., Cambridge, MA 02139, (617) 395-8350; fax (617) 395-1281.
Circle 1305 on Inquiry Card.

Customize Your CAD Linetypes

The professional-looking results of linetype annotation are now available for users of all CAD programs that can read and write DXF files. Originally available only for AutoCAD, Universal C-Line lets you assign meaning to different types of lines and routes in engineering, mapping, and many other applications.

Universal C-Line is available in three versions—Lite, Standard, and Professional—and supplies up to 130 linetypes, depending on which version you use.

Price: Lite version, $295; Standard version, $495; Professional version, $695.
Contact: M. Slinn Engineering Services, Inc., 3158 West 32nd Ave., Vancouver, B.C., Canada V6L 2C1, (800) 663-8045 or (604) 266-5380; fax (604) 266-5348.
Circle 1306 on Inquiry Card.



In this Universal C-Line map, the light blue line represents a stream, pink shows elevation, dark blue shows gas lines, green represents the tree line, and yellow marks a dirt road.

Major Visual Impact, Minor Wallet Damage

Aimed at the nonartistic user who needs an easy tool for producing polished presentation materials, Micrografx's Windows Draw provides a heavily featured illustration program at a relatively low price.

Windows Draw provides Bézier curve editing, outline fonts, and effects such as text on a curve and blending. Drawing tools include freehand, line, and curve, and you can use rotate and reshape functions to alter your view of your work.

Windows Draw includes ClipArt Manager, which lets you search the program's 2600 clip-art images by symbol name or by filename. If all that clip art doesn't meet your needs, you can import images using Windows Draw's 30 import and export filters. You can import 24-bit scanned color TIFF and PCX images for display, manipulation, or printing.

Price: $149.95.
Contact: Micrografx, Inc., 1303 Arapaho, Richardson, TX 75081; (800) 733-3729 or (214) 234-1769; fax (214) 234-2410.
Circle 1307 on Inquiry Card.



THE DELL 486P/20 20 MHz i486SX SYSTEM.*
SYSTEM INCLUDES 50MB HARD DRIVE, VGA COLOR MONITOR, AND 2MB RAM.

HE MORE YOU SAVE.

e've just mentioned, here's an amazing fact: feature for feature, you can get an
our savings increase with the sophistication of the Dell System® you buy. So go ahead, read on.
how the more our i486 systems cost, the less they actually cost.

MORE SPEED

From desktop publishing to spreadsheet applications, there's one feature that's always welcome, and that's speed. With quick recalcs and lightning fast screen refreshes, you'll get your work done faster with the Dell 486P/33.

The 33MHz i486DX processor generates up to 80% more performance than 33MHz i386DX systems. If that leaves you craving for more, you can upgrade to a faster i486 processor when available.

This 486P/33 configuration features a 100 MB hard drive with a phenomenal 15 ms average access time. An 8 KB cache in the processor boosts performance. And dual floppy drives allow you to read any diskette, regardless of MS-DOS format.

A 1024 x 768 non-interlaced big 15" color monitor with overscan gives you 30% more viewable area than the standard 14" you get with any competitively priced system. For even more versatility on desktop publishing or graphic-intensive applications, just expand video RAM to 1 MB and you'll get a 32,000 color, near-photograph quality display.

The system comes with 4 MB RAM on 32-bit SIMMs with gold-plated connectors, MS-DOS 5.0, Microsoft Windows 3.0 and a Microsoft Mouse.



THE DELL 486P/33 33 MHz i486DX SYSTEM.*
SYSTEM INCLUDES 100 MB HARD DRIVE, ULTRASCAN 15C MONITOR, 5.25" 1.2 MB AND 3.5" 1.44 MB FLOPPY DRIVES AND 4 MB RAM.
SAVE $948▽

MORE GRAPHICS

The Dell 486D/33 has every high-end feature you'd expect in an outstanding graphics workstation. Except a high-end price tag.

There's a superfast 33 MHz i486DX processor, with 8 KB internal cache. For even greater performance, all you'll need to do is replace a processor chip. So you can upgrade inexpensively as soon as new chips hit the market.

Should your workload, heaven forbid, triple by then, you'll still find the 200 MB hard disk more than adequate.

And as your requirements become increasingly more sophisticated, you can keep adding to the 486D/33's 8 MB RAM. With a maximum of 64 MB, there's plenty of room to grow.

Talking about room, we have a large 15" flat square monitor with 30% more viewable area than a standard 14" monitor, which makes those large spreadsheets and high resolution documents much easier to read.

The Dell 486D/33 comes with factory-loaded MS-DOS 5.0, Microsoft Windows 3.0 and a Microsoft Mouse.

intel inside™ ☆



THE DELL 486D/33 33 MHz i486DX SYSTEM.*
SYSTEM INCLUDES 200 MB HARD DRIVE, ULTRASCAN (1024 x 768) 15C MONITOR, 5.25" 1.2 MB and 3.5" 1.44 MB FLOPPY DRIVES AND 8 MB RAM.
SAVE $1,348▽

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y interest in the marks and names of others. △Service provided by third party servicer. On-site service may not be available in certain remote locations. Shipping, handling and applicable sales tax not included in the price.


9033 A0016K
HM511000AJP8H
Gold-plated SIMMs increase system reliability by eliminating connection-related errors.
There are plenty of companies anxious to sell i486 systems at a low price. All they really need is a supply of parts (the cheaper, the better) and a garage to assemble them in. Once the "production line" gets going, they place a few ads in the paper. After that, of course, it's anyone's guess as to which will last longer: the computer or the "company" it came from.
The 486P/20 is one of the few computers to feature 16 MB SIMMs.
At Dell, on the other hand, we offer lower prices by cutting down on traditional retailer mark-ups, not quality. In fact, we're almost fanatical about the quality of every machine that leaves our state-of-the-art factory. That attitude is reflected in the way we design, test, manufacture and ship our i486 systems.
To see how our i486 systems stand up to air delivery, we use a Black Box. Or, in technical parlance, a portable accelerometer/thermometer. This little device is fitted into a test computer which we then send out through regular delivery channels, much as if you had ordered it yourself. When we bring it back, the "Black Box" tells us exactly what the computer went through, in terms of shock, vibration and temperature. This innovative test is part of a series that's been so successful in helping us improve our packaging, we've won an international award for package design.
Our Black Box test makes sure your Dell computer never arrives this way.
To make our computers more reliable, we cook them. After our computers are fully assembled and configured, randomly selected units are "burned-in" and tested at 104°F.
In perhaps the most grueling temperature test we've ever come up with, pilot Dell systems must survive a storage chamber where temperatures vary rapidly between —40°C and +60°C.

THE MORE YOU GET,

If your requirements call for a more powerful or specialized system than the one
even *better* deal with our higher-end i486 systems. From $248 all the way up to a whopping $1,348
And if you still have any doubts, call us. We'll be happy to expla

MORE VALUE

The Dell 486P/20 is a 20 MHz i486SX general purpose workstation you can upgrade to 33 MHz and beyond.

For a configuration that costs so little, you sure get a lot.

Like programmable Flash EPROMs for easy BIOS upgradeability.

And an 80 MB hard disk drive with 15 ms access time.

And an 8 KB cache built into the processor for increased throughput.

And 4 MB of RAM on 32-bit SIMMs with gold-plated connectors for greater reliability.

And 2 floppy drives.

Surprised? Keep reading.

You'll also get a 1024 x 768 14" color monitor with long persistence phosphors.

And the power to display 32,000 colors simultaneously, if you expand video memory to 1 MB.

And factory-installed MS-DOS® 5.0 and Microsoft Windows 3.0.

And a Microsoft Mouse.

And, considering it's from Dell, a whole lot of peace of mind.

That, by itself, is worth a fortune.



THE DELL 486P/20 20 MHz i486SX SYSTEM.*
SYSTEM INCLUDES 80 MB HARD DRIVE, SUPERVGA (1024 x 768) COLOR MONITOR, 5.25" 1.2 MB AND 3.5" 1.44 MB FLOPPY DRIVES AND 4 MB RAM.

SAVE $248▽

MORE PRODUCTIVITY

The Dell 486D/25 is a sophisticated productivity workstation that was designed with your future in mind. To upgrade from a 25 MHz i486SX processor to a faster processor when available, all you'll need to do is replace a processor chip. Not a card. And starting with 4 MB, you can keep adding RAM up to a maximum of 64 MB.

This new system is priced on par with 33 MHz i386DX machines, yet performs up to 40% faster. And its sheer processing power is amply backed by a 100 MB hard drive with a 32 KB cache for increased throughput. A dual floppy drive completes the excellent storage arrangement.

A 1024 x 768 14" color monitor with a 70 Hz refresh rate gives you a flicker-free display. With 32,000 colors, if you make a small expansion of video RAM. Should anything go wrong, the built-in SmartVu™ diagnostic display can find the problem, even if the monitor goes down.

The 486D/25 comes with six expansion slots and five drive bays for added flexibility. You'll also get factory-loaded MS-DOS 5.0, Microsoft Windows 3.0 and a Microsoft Mouse.



THE DELL 486D/25 25 MHz i486SX SYSTEM.*
SYSTEM INCLUDES 100 MB HARD DRIVE, ULTRASCAN™ 14C MONITOR, 5.25" 1.2 MB AND 3.5" 1.44 MB FLOPPY DRIVES AND 4 MB RAM.

SAVE $748▽

WE THINK A COMPUTER SHOULD COME WITH MORE SUPPORT THAN THIS.

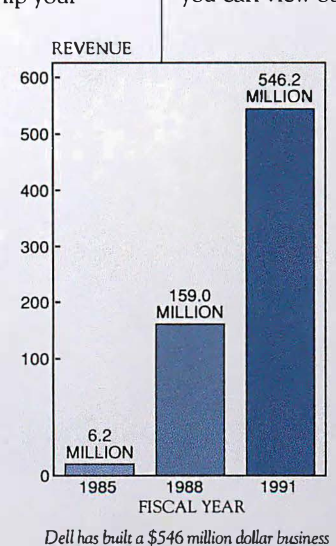
As a potential buyer, you'll receive lots of attention from most computer companies. Until they receive your check, that is. For all practical purposes, once the sale is closed, so is the company.

At Dell, on the other hand, half our story begins after you receive your computer. Despite our low prices, we've built a reputation for the highest level of support in the industry.

To begin with, a Dell expert works with you to figure out which computer, with which options, works best for you. We help you arrange financing from a wide variety of credit, lease and lease-to-buy plans. Then we test, pack and ship your personalized personal computer to you via two-day air standard.

In the unlikely event that you have a problem with your computer, it won't last long. Our technical support staff solves 90% of reported problems over the phone. Usually in six minutes or less.

You can also get technical help 24 hours a day via our innovative TechFax[SM] line. Just dial up and detailed system information will be automatically faxed back to you from the Dell Technical Library.



Dell has built a $546 million dollar business by building a relationship with every customer.

We even have a special section on CompuServe's PC vendor forum. So you can view other users' problems, and, more importantly, our solutions. But what makes our bulletin board special is that we constantly monitor what goes on there. Which means we can keep track of any small problems, and stop them before they become big ones.

But what if you have a problem that just can't be solved over the telephone?

On-site service is an ambiguous term.

To some enterprising vendors, it conveniently means that the replacement parts, and not the service technician, will arrive on-site. Which isn't as crazy as you may imagine; there are any number of do-it-yourself computer whiz kids in this business.

If you don't count yourself among their

ranks, you'll prefer Dell's way of supporting our machines.

If needed, a trained technician can be at your home or office with a solution in hand, usually by the next business day.△

What's more, every time you call Dell Tech Support an entry is made in our customer database. So over time, we'll know your computer as well as you do. Maybe even better.



Every Dell Computer comes with a trained computer staff who knows your computer as well as you do. Maybe better.

And you get all this support without getting a bill. Because the price of your system includes on-site service coverage for a year, and phone support forever.

Buy a computer and get the company.

By standing firmly behind every machine we've ever sold, we've built up a $546 million company in just seven years, one customer at a time.

On the way, we've acquired quite a following. For example, the editors at *PC Week* have described the Dell service and support package as "overkill." J.D. Power and Associates® ranked Dell "Best PC in Customer Satisfaction in Small to Medium Sized Businesses."

We've won *PC Week's* Customer Satisfaction Poll an unprecedented eight times.

And in the last 12 months alone, we've collected 53 product awards, including *PC Magazine's* Editor's Choice, *InfoWorld's* Buyer's Insurance and *PC World's* Best Buy and World Class Awards.

And it's not just the smaller users that are satisfied, either: Dell computers are now used by over two-thirds of the FORTUNE 500.®

Last year, Dell won customer satisfaction polls in the U.S., U.K., Germany and France.

Overseas, it's been pretty much the same story. We've more than doubled our overseas sales in the last 3 years in a row, and won in customer satisfaction surveys in the UK, Germany and France.

Still can't decide? Take 30 days to make up your mind. Within that time, if you aren't completely satisfied, just return your Dell system and we'll refund your money, no questions asked.

We're proud to add, though, that this unconditional guarantee has been used so sparingly, only 1.2% of the over half a million computers we've sold so far have ever come back.

What does keep coming back, in ever increasing numbers, are our customers. Over 70% of the people who buy a Dell computer buy another. That's perhaps the strongest statement of satisfaction any manufacturer could ever hope to receive.

So before you buy an i486 system, ask





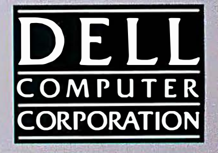




Our 53 product awards in 1991 alone make Dell one of the most awarded PC companies in the world.

around; there are plenty of Dell users out there. And if there's anything you need, call us. But you'd better hurry.

Great computers may last a long time but great deals don't.



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FAX SHEET

SEND US THE FAX AND WE'LL SEND YOU THE FIGURES.

Fill this out, fax it to us and we'll send back a price quote, spec sheet and any other information you may need on our line of i486 systems.

PROCESSOR
- ☐ i486SX, 20 MHz
- ☐ i486SX, 25 MHz
- ☐ i486, 33 MHz
- ☐ i486, 50 MHz

ARCHITECTURE
- ☐ EISA
- ☐ ISA

CHASSIS
- ☐ Small Footprint
- ☐ Mid-Size
- ☐ Floor-Standing

DISKETTE DRIVES
- ☐ 3.5"
- ☐ 5.25"

MEMORY
- ☐ 4 MB
- ☐ 8 MB
- ☐ 16 MB

HARD DRIVES
- ☐ 50 MB
- ☐ 80 MB
- ☐ 100 MB
- ☐ 200 MB
- ☐ 320 MB
- ☐ 650 MB
- ☐ Other

MONITORS
- ☐ VGA Color, 14", 640 x 480, .39mm dot pitch
- ☐ VGA Color Plus, 14", 640 x 480, .31mm dot pitch
- ☐ Super VGA Color, 14", 1024 x 768, 28mm dot pitch
- ☐ UltraScan 14C, 14", 1024 x 768, .28mm dot pitch non-interlaced, 70Hz
- ☐ UltraScan 15C, 15", 1024 x 768, .28mm dot pitch non-interlaced, 70Hz
- ☐ GPD-16C, 16", 1280 x 1024, .31mm dot pitch
- ☐ GPD-19C, 19", 1280 x 1024, .31mm dot pitch

OPERATING SYSTEMS
- ☐ MS-DOS 3.3
- ☐ MS-DOS 4.01
- ☐ MS-DOS 5.0
- ☐ MS-OS/2 1.21
- ☐ Dell UNIX® System V

OTHER (i.e.: tape drive, network card, mouse or modem)

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Title ____________________

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Address ____________________

City ________ State ______ Zip ______

Fax Number ____________________

Please have a Dell representative call me at

( ) ____________________

DELL COMPUTER CORPORATION

800-727-8320

FOR MORE INFORMATION, PLEASE FAX US.
#11E56

MenuWorks Keeps Private Data Private

MenuWorks Total Security provides PC security via a wide variety of tools. The program offers security through start-up control, access control, auditing and tracking, and data encryption. Access control is provided through user log-on, locking of selected drives and directories, controlling access to individual files, and locking DOS commands.

MenuWorks Total Security provides Data Encryption Standard–compliant encryption through the creation of multiple virtual drives on any one storage device. The administrator designates the virtual drive or drives that are to be encrypted.

Price: $149.95.

Contact: PC Dynamics, Inc., 31332 Via Colinas, Suite 102, Westlake Village, CA 91362, (800) 888-1741 or (818) 889-1741; fax (818) 889-1014.

Circle 1002 on Inquiry Card.

Power-Launch with hDC

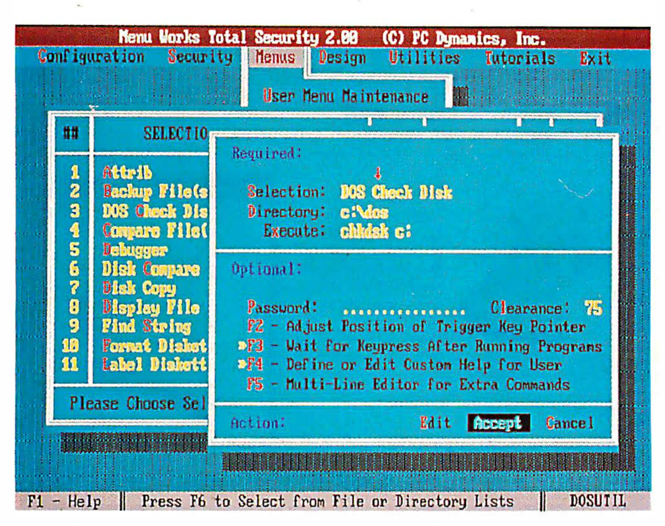
The latest offering by hDC is a Windows utility that combines the functionality of a system menu launcher, a virtual screen driver, a command scheduler, and a task manager.

Power Launcher lets you launch, individually or in combination, any application, document, script, or macro with a single click of the mouse. You can expand the desktop's virtual screen to as much as 64 times the current size.

Price: $99.95.

Contact: hDC Computer Corp., 6742 185th Ave. NE, Redmond, WA 98052, (206) 885-5550; fax (206) 881-9770.

Circle 1000 on Inquiry Card.



MenuWorks' password-protection control is one of the utility's many security tools.

Get the Most from Your Memory

StuffIt SpaceMaker incorporates two compression functions in a single software package. The Aladdin product features on-the-fly and automatic background compression capabilities.

To compress a file or folder, you need only attach a preset keyword to the document's name. Once you've attached the keyword, SpaceMaker works transparently.

SpaceMaker's Idle-Time Compression feature automatically compresses data while your Mac is idle. You can specify particular disks, files, or folders that should not be compressed by Idle-Time, or you can turn off the feature altogether.

SpaceMaker compresses most files to half their original size, and it can compress some files, such as graphics and database information, by as much as 98 percent. According to Aladdin, the software works with all Mac applications, and it can compress data at speeds comparable to those of hardware-based compression boards.

You can also create StuffIt Deluxe and self-extracting archives. The program includes Aladdin's StuffIt Engine.

Price: $59.95.

Contact: Aladdin Systems, Inc., 165 Westridge Dr., Watsonville, CA 95076, (408) 761-6200; fax (408) 761-6206.

Circle 1003 on Inquiry Card.

SuperStor removes data redundancy and can automatically compress your files to a third of their original size when you write them to disk. AddStor's new package performs on-the-fly data compression transparently.

Because it is a software-only product, SuperStor does not require an expansion slot or additional hardware. According to AddStor, the program's compression capabilities equal or exceed those of plug-in boards. SuperStor is compatible with any hard drive, Plus Card, Bernoulli Box, or floppy drive running DOS or Windows.

Price: $139.

Contact: AddStor, Inc., 3905 Bohannon Dr., Menlo Park, CA 94025, (800) 732-3133 or (415) 688-0470; fax (415) 688-0466.

Circle 1004 on Inquiry Card.

Keep an Eye on Your Power

Monitoring your computer's power source is a job more easily done with a little help. Systems Enhancement offers two products that provide power monitoring across a host of operating environments.

PowerMon (for OS/2 LAN Manager, 3+ Open OS/2 LAN Manager, and OS/LAN Server) and SmartMon (for SCO Unix, SCO Xenix, System V release 4, DEC VMS, SunOS, and Interactive Unix) alert you to changes in your system's power supply and let you set up a procedure for the monitoring system to follow in the event of a power disruption.

PowerMon comprises software and cables that monitor your uninterruptible power supply (UPS) by constantly checking for power failure. On discovering a failure, PowerMon follows your predetermined directions, which can include a system shutdown.

SmartMon lets you display or print information pertaining to the status of your UPS's batteries and utilities.

Price: PowerMon, $149; SmartMon, $199 and up (depending on operating system).

Contact: Systems Enhancement Corp., 761 Spirit of St. Louis Blvd., Chesterfield, MO 63005, (314) 532-2855; fax (314) 537-2791.

Circle 1001 on Inquiry Card.

Wang Integrates Non-GUI Applications

Wang's new UpWord 2.0 document-processing program for Windows 3.0 integrates with Windows and non-Windows applications and offers workgroup computing and image management. The program's compound document management capability lets you keep documents and related external images together when copying, renaming, moving, or deleting files.

Wang says that UpWord 2.0's ability to link with non-Windows applications, such as Lotus 1-2-3 and dBase, lets you enjoy Windows document processing without having to shift all your applications to a GUI.

UpWord's workgroup functions support redlining and revision tracking.

Price: $495.

Contact: Wang Laboratories, Inc., 1 Industrial Ave., Lowell, MA 01851, (508) 459-5000.

Circle 1005 on Inquiry Card.

Two DTP Programs for Windows 3.0

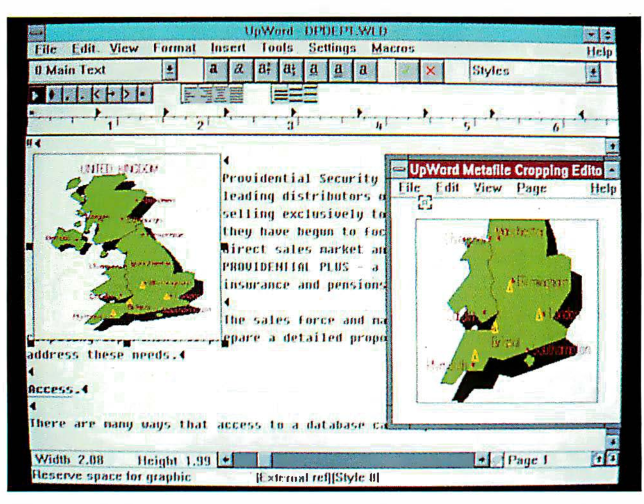
Express Publisher for Windows is for the business user who wants to create professional-looking ads, newsletters, brochures, flyers, and other design-intensive documents. The program offers templates called Express Designs that include layouts and styles.

Express Publisher for Windows provides thumbnail previews, which are live thumbnail graphical representations of document templates, clip art, fonts, spacing, and alignment options that you can edit. With Express Publisher for Windows, you can rotate text, text frames, and other page elements. The program comes with Adobe Type Manager, 13 font outlines, and 20 predesigned templates. A built-in spelling checker is also included.

Price: $249.95.

Contact: Power Up Software Corp., 2929 Campus Dr., San Mateo, CA 94403, (415) 345-5900; fax (415) 349-1356.

Circle 1006 on Inquiry Card.



UpWord 2.0 lets you crop, scale, or size images as needed. Within the cropping editor, you can invoke a graphics editor, such as CorelDraw for Windows 3.0, for further image enhancement.

Windows users looking for an inexpensive desktop publishing program can buy PagePlus for Windows for less than $150. The program offers text and image rotation, typographic control, and an electronic pasteboard for creating publications.

PagePlus for Windows lets you control text point sizes from 4 to 250 points in ⅒-point increments, Serif says. The program offers expand, condense, slant, kern, letter-space, outline, and pattern features. It imports text and graphics from a variety of applications.

Price: $149.

Contact: Serif, Inc., P.O. Box 803, Nashua, NH 03061, (603) 889-8650; fax (603) 889-1127.

Circle 1007 on Inquiry Card.

Page Layout for the Amiga

PageSetter III, an enhanced version of Gold Disk's entry-level page layout program, provides text and graphics creation as well as a layout system for the Amiga. Along with a word processor and spelling checker, the program offers a color paint program and clip art.

New output capabilities include PostScript compatibility and color printing of bit maps and art. PageSetter III runs on any Amiga, and it is compatible with Workbench 2.0.

Price: $129.95.

Contact: Gold Disk, 5155 Spectrum Way, Unit 5, Mississauga, Ontario, Canada L4W 5A1, (416) 602-4000; fax (416) 602-4001.

Circle 1010 on Inquiry Card.

Create Font Special Effects

MakeUp, a program for Windows 3.x that lets you create special effects with type, combines text manipulation and graphics for creating logos, illustrations, banners, and mastheads. MakeUp supports PostScript Type 1, TrueType, and Bitstream Speedo type, and it doesn't require a separate font-scaling utility.

MakeUp ships with five typefaces. You can rotate, stretch, flip, and otherwise manipulate text with MakeUp. You can even pour text into customized shapes, Bitstream reports. The program supports color.

Price: $149.

Contact: Bitstream, Inc., 215 First St., Cambridge, MA 02142, (617) 497-6222.

Circle 1008 on Inquiry Card.

Power Up Software's TextAppeal for Windows lets you create more visually interesting documents with custom headlines, logos, bursts, and other text effects. It combines type manipulation, drawing tools, and the ability to import and export graphical images.

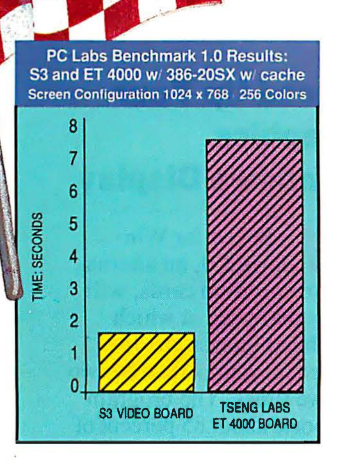
With TextAppeal, you can curve, rotate, shadow, and stretch type to create an image for your document. You can combine text with lines, curves, and boxes created with the program's drawing tools and clip art to produce custom logos, bursts, and headlines.

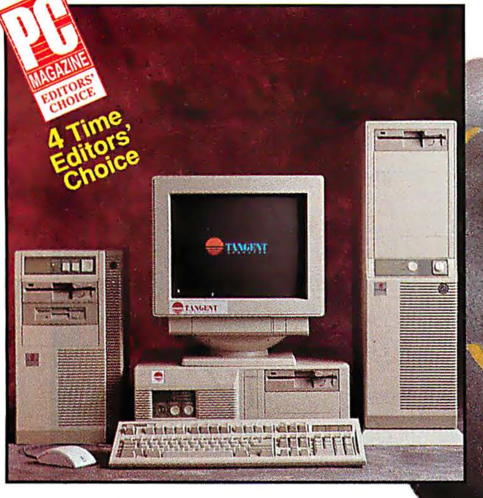
Price: $129.95.

Contact: Power Up Software Corp., 2929 Campus Dr., San Mateo, CA 94403, (415) 345-5900; fax (415) 349-1356.

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RUN WINDOWS 5 TIMES FASTER!





PRODUCT MATRIX

	Value Systems	Performance Systems	Power Systems
Intel386 SX 20 MHz	$1,550	$2,195	$2,845
Intel386 25 MHz	$1,650	$2,295	$2,945
Intel386 33 MHz	$1,895	$2,540	$3,190
Intel486 25 MHz ISA	$2,350	$2,995	$3,645
Intel486 25 MHz EISA*	N/A	$4,795	$3,445
Intel486 33 MHz ISA	$2,495	$3,140	$3,790
Intel486 33 MHz EISA*	N/A	$5,095	$5,745
Motherboard with cache 1.2 or 1.44 floppy One parallel and two serial ports Enhanced 101 key-keyboard	2 MB RAM 52 MB 17 MS drive 16 bit SVGA card with 512K RAM 14" SVGA color monitor 1024 x 768	4 MB RAM 119 MB 15 MS drive Tangent S.3 graphics card w/ 1 MB RAM 14" SVGA NI color monitor 1024 x 768 MS-DOS 5.0 MS-Windows 3.0 Mouse	8 MB RAM 210 MB 15 MS drive Tangent S.3 graphics card w/ 1 MB RAM 14" SVGA NI color monitor 1024 x 768 MS-DOS 5.0 MS-Windows 3.0 Mouse

*Includes EISA disk caching controller and SCSI drive.

Revolutionary new Windows accelerator!

Another breakthrough from Tangent! The new S-3 graphics accelerator, available on our 386 and 486 systems! The S-3 sets new standards of Windows performance—running *five times faster* than systems using ordinary boards, based on PC Labs Windows Benchmarks (v. 1.0).

The S-3 even has hardware cursor control to eliminate cursor lag, and make you more productive.

Get 32,000 photoreal colors! And our fastest drives ever!

Tangent's new systems are available with the Sierra Hi-Color RAMDAC, for photorealistic images using up to 32,000 on-screen colors. You can also take advantage of non-interlaced, VESA-compliant flicker-free displays, and high speed drives that are even faster than our previous award-winning models.

You win with Tangent.

The new S-3 is just one more reason Tangent leads the way in PC engineering. No wonder we've won *four* PC Magazine Editor's Choice awards in the last 18 months!

From award-winning workstations to the industry's fastest network servers, our systems deliver unbeatable performance and value. You get the latest technology innovations—at prices our competitors can't touch.

Each system has a one-year parts and labor warranty. Plus on-site service through TRW *and* toll-free technical support!

Limited Offer: Free Windows and Mouse!

Experience this new level of exhilarating Windows performance! Buy any Tangent Performance System or Power System before January 31, 1992, and we'll give you a copy of Microsoft Windows 3.0 *and* a mouse—*free*!

Call (800) 223-6677 right now!
FAX: (415) 342-9380









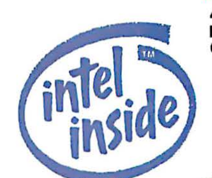
4 Time Editors Choice













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GSA Number: G500K91AG5212. Corporate Purchase Orders and European Orders Welcome!
Windows/Mouse offer expires January 31, 1992.

The Intel Inside logo, Intel386 and Intel486 are trademarks of Intel Corp. Other product names are trademarks or registered trademarks of their respective companies.

All prices subject to change without notice.

Circle 577 on Inquiry Card.

Convert Fonts into TrueType

The FontMonger type-manipulation program for PCs lets you convert your existing type library into TrueType format for use with Windows 3.1.

FontMonger converts font files in any direction among the major font formats. It can also automatically convert selected characters or entire fonts into Adobe Illustrator and Encapsulated PostScript file formats (for both Windows and Mac graphics applications) and the Windows metafile format. Like the Mac version of FontMonger, the Windows version offers a blend of type-modification capabilities.

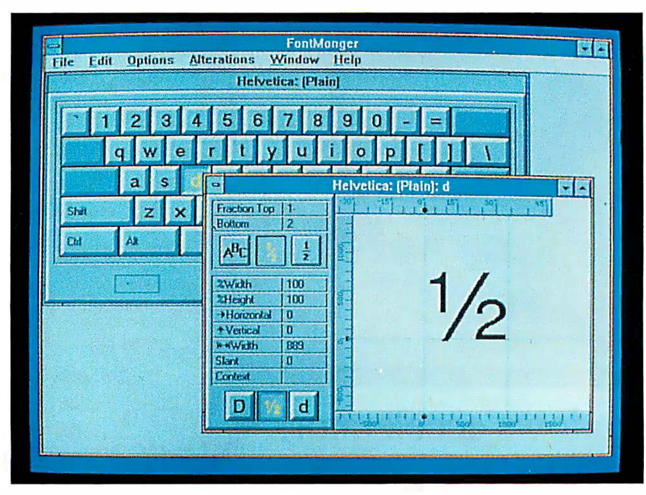
FontMonger enables you to generate inferior and superior characters for mathematical and scientific formulas, pricing, and fractions directly from your keyboard.

Using FontMonger, you can combine type with graphics and merge it back into a font for immediate access and quick placement of frequently used graphics and logos.

Price: $99.95.

Contact: Ares Software Corp., 561 Pilgrim Dr., Suite D, Foster City, CA 94404, (415) 578-9090; fax (415) 378-8999.

Circle 1013 on Inquiry Card.



Using FontMonger's Alter Character window, you can assign specialized characters to specific keys on your keyboard.

Paging Doctor PC

The next time you're feeling ill, try asking your PC for medical advice. Schueler's Home Medical Advisor (HMA) is a reference system that provides information on self-care, preventative medicine, and symptom analysis.

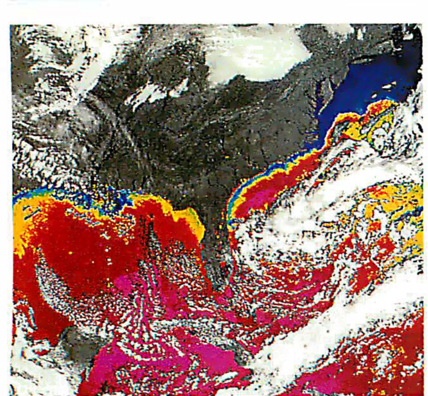
Designed by a team of emergency-room physicians, the program uses an interrogative format to diagnose your problem. HMA's topic files cover symptoms, diseases, injuries, poisons, drugs, medical tests, and specialist referrals.

HMA includes hundreds of images to help you distinguish between similar conditions. The program is not intended to be a substitute for the doctor. Once you've consulted HMA, you'll know what to expect when you seek treatment, and you'll be better able to choose specialists.

Price: $99.95.

Contact: Pixel Perfect, Inc., 10460 South Tropical Trail, Merritt Island, FL 32952, (407) 777-5353; fax (407) 777-0323.

Circle 1011 on Inquiry Card.



U.S. and Soviet polar-orbiting satellites provide the weather feeds to SatView.

Weather Images from Space

Now you can receive real-time U.S. and Soviet satellite images on your Macintosh. SatView gathers data from satellites that orbit the earth every 100 minutes, and it displays cloud cover and ocean surface temperatures worldwide. SatView offers image-processing and -analysis software and a NuBus card with an onboard processor for image digitization and storage.

Price: $3950.

Contact: Marisys, Inc., 2905 South Federal Hwy., Suite C-10, Delray Beach, FL 33483, (407) 272-3490; fax (407) 272-3485.

Circle 1015 on Inquiry Card.

Speed Up Your Graphics Windows Display

WinSpeed for Windows 3.0, an alternative to speed-up cards, will boost the speed at which graphical images are displayed on your screen by two to five times. The program supports about 85 percent of the Super VGA cards on the market.

Price: $79.

Contact: Panacea, Inc., Post Office Sq., Suite 4, 24 Orchard View Dr., Londonderry, NH 03053, (603) 437-5022; fax (603) 434-2461.

Circle 1014 on Inquiry Card.

New Authorware Supports Multimedia

With Authorware Professional for Windows, you can develop interactive applications that support CD audio, MIDI, animation, and Windows sound. Authorware says that the Windows 3.0 version is a complement to the Mac version, providing almost 100 percent conversion of application structure and content.

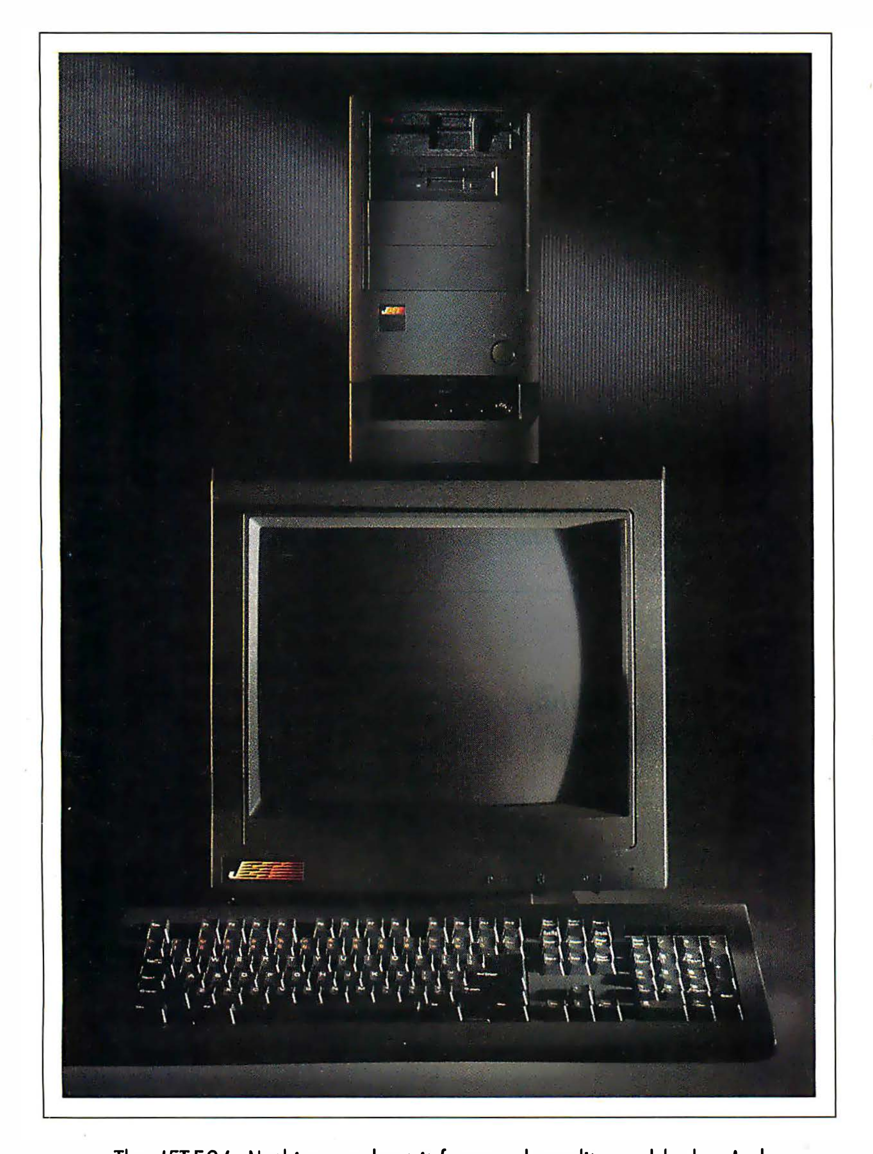
The program comes with an object-authoring interface for nontechnical users. You can build sophisticated applications without scripting, the company reports. As you create your application, Authorware guides you through development with a graphical map.

Price: $8000.

Contact: Authorware, Inc., 275 Shoreline Dr., Suite 535, Redwood City, CA 94065, (415) 595-3101; fax (415) 595-3077.

Circle 1012 on Inquiry Card.

JET-BLACK



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Includes: 33MHz 80486 with 512K cache, AMI Bios ▪ 8MB of 60ns RAM (can upgrade to 64MB) Full tower case with digital display and second fan ▪ 400 Watt power supply ▪ TEAC 1.2MB and 1.44MB diskette drives ▪ 213MB IDE hard drive with 64K cache, 15 millisecond ▪ Diamond SpeedStar Plus with Hi-Color chip (32,000 colors) ▪ Non-interlaced monitor with 72Hz refresh ▪ 101 key tactile keyboard ▪ 1 parallel, 2 serial, 1 game port ▪ DOS 5.0 with manuals ▪ Windows 3.0 ▪ Black mouse and pad ▪ Other configurations available



JET Computer, 2090 E. University, #101 Tempe, AZ 85281, Telephone (602) 967-2130, Fax (602) 967-3610

Circle 578 on Inquiry Card (RESELLERS: 579).

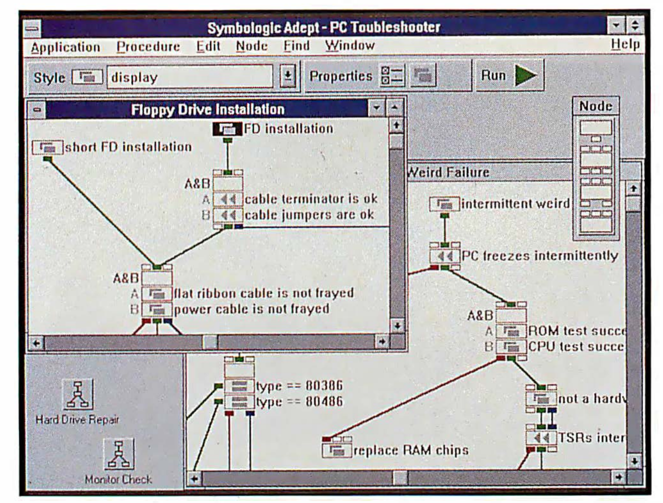
Expert Systems Through Diagraming

An upgrade of the Adept expert-system development tool lets you model business and technical procedures and turn them into interactive software applications that guide an end user through complex tasks.

Adept 2.0, which runs under Windows 3.0, lets you create a graphical depiction of expert procedures—much as you would create a flowchart—to develop a clear picture of the choices and the alternatives. Adept 2.0 doesn't force you to create an expert system using if-then statements.

Other new features include graphical debugging and Dynamic Data Exchange. The program uses a visual programming method and lets you insert changes into your system at any point.

Price: $695.
Contact: Symbologic Corp., 15379 Northeast 90th St., Redmond, WA 98052, (206) 881-3938; fax (206) 881-7198.
Circle 1016 on Inquiry Card.



By creating a graphical depiction of the procedures that experts use, Adept 2.0 turns real-life decisions into interactive software programs.

Testing for Unix, OS/2, and Windows

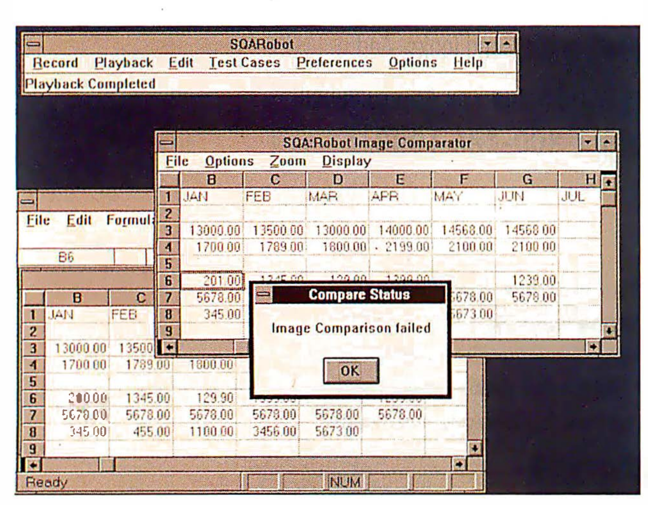
As GUI applications become more complex, especially LAN-based and groupware programs, it's getting harder to find, track, and fix software bugs. Software Quality Automation's SQA:Robot lets you execute a standard test and play back the results during system testing.

SQA:Robot can record all functions of the GUI environment, including mouse and keyboard activities and window moving, resizing, and scrolling. Advanced script logic and test-execution/validation techniques are also included. SQA says the program is integrated with Visual Basic, which lets you interact with nonproprietary scripting languages in modifying test scripts.

SQA:Robot works with SQA:Manager, SQA's software test management program. SQA:Manager consists of three tools: the test manager, the problem tracker, and the analyzer.

SQA:Manager works under DOS, Windows 3.0, OS/2 Presentation Manager, and the X Window System under Unix. SQA:Robot works under Windows and OS/2.

Price: SQA:Robot for Windows, $695; SQA:Robot for Presentation Manager, $995; SQA:Manager, $3500 and up.
Contact: Software Quality Automation, 1 Parker St., Lawrence, MA 01843, (800) 228-9922 or (508) 689-0182; fax (508) 689-4195.
Circle 1019 on Inquiry Card.



SQA:Robot's record/playback functions let you conduct performance and regression tests on GUI modules. The version for Windows 3.0 is shown here.

Field Validation for Windows Applications

For use with any Windows dialogue editor (e.g., the dialogue editors of the Software Development Kit or WindowsMaker Professional), Magic Fields offers a collection of objects that perform data-field validation. The collection includes objects that perform numeric, text, date, and other data-field validation. Without programming, you can also define fields such as employee number and invoice number.

Price: U.S. version, $295; international version, $369.
Contact: Blue Sky Software Corp., 7486 La Jolla Blvd., Suite 3, La Jolla, CA 92037, (619) 459-6365; fax (619) 459-6366.
Circle 1018 on Inquiry Card.

Learn Windows Programming Fast

An interactive system from IntelligenceWare teaches you Windows 3.0 programming techniques with hypertext, graphical tutorials, and source code annotations and explanations. Source code explanations in WindowsTeach are provided with hypertext clarifications in a multiwindow environment.

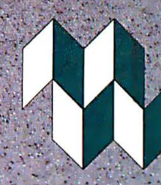
WindowsTeach's concepts component explains the structure of Windows, and the programs component offers 21 structured programs, each illustrating a feature of Windows.

Price: $123.
Contact: IntelligenceWare, Inc., 5933 West Century Blvd., Los Angeles, CA 90045, (213) 216-6177; fax (213) 417-8897.
Circle 1017 on Inquiry Card.

Break Through to 32-Bit Windows Application Development



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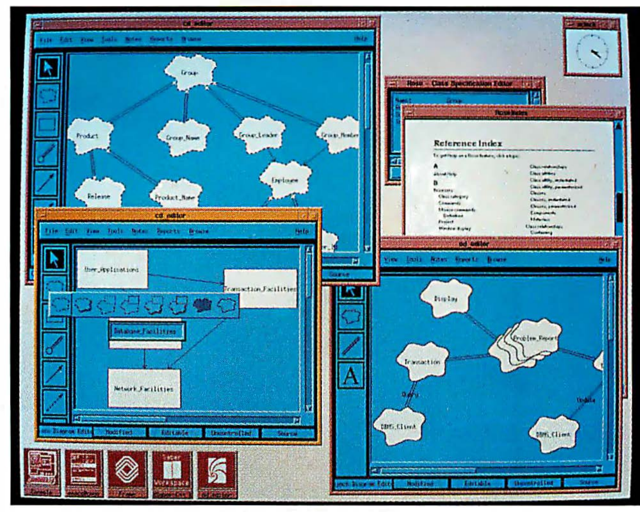
Software Engineering for X

Rational Rose, a graphical object-oriented analysis and design tool, offers a client/server software tool for language-independent analysis and design on the IBM RISC System/6000 and Sparcstation compatibles.

You can access Rose from any X Window System–compliant display running Motif or Open Windows. Rose supports languages such as C++, Ada, Smalltalk, and C. It also supports the Booch programming method.

Rose offers class browsers and reusable libraries. The semantic information stored in Rose's repository is accessible through a set of open interfaces, letting you integrate the program with third-party tools and frameworks.

An object-oriented database and a desktop publishing system come with Rose.
Price: $3995 per license.
Contact: Rational, 3320 Scott Blvd., Santa Clara, CA 95054, (408) 496-3692; fax (408) 496-3638.
Circle 1022 on Inquiry Card.



Rational Rose shows the highest-level view of a problem-reporting system in the class-diagram editor at lower left. The upper left window contains a class-diagram editor that shows a decomposition of one of the class categories—that of user applications. At right, the class specification editor lets you examine the behavior of each class, and the object diagram editor lets you examine key mechanisms and how they work in the system. Also shown at right is the hypertext help system. Rose integrates with applications from Frame and Saber.

Unix Desktop Without Clutter

The new version of the Wish (for Window Iconic Shell) program development and delivery desktop for Unix, Motif, and Network File System distributed computing minimizes the use of screen space and provides file and application management. Non Standard Logics says Wish eliminates the proliferation of windows that you often find in graphical desktops. Wish2 includes Wx2, the company's graphical programming editor for Motif.

Wish2's main window has a current-directory panel and a tool-tray panel for docking frequently used tools, files, and applications. Wish2's command window uses the AutoRecall feature to supply you with lengthy path names automatically. You can type `rm` and click on an icon. Once you click on the file icon, a long command sequence, such as `rm /usr/export/sony/ns/demo/newfile`, can appear on the command line. On-line help is available. Wish2 requires OSF/Motif 1.1.
Price: Starts at $695 (depending on platform and quantity).
Contact: Non Standard Logics, Inc., 4141 State St., Suite B-11, Santa Barbara, CA 93110, (805) 964-9599; fax (805) 964-4367.
Circle 1020 on Inquiry Card.

An X Debugger for Real-Time Unix

A debugging tool for real-time Unix and Posix that operates in the X Window System interface or the ASCII terminal mode, LDB offers source- and kernel-level debugging of multiple threads and processes. LDB's features include signals debugging; support for break, watch, and trace points; stepping; and stack examination. LDB can also debug a program on a remote system via an Ethernet link.

The initial release of LDB supports LynxOS. Versions are planned for standard variations of Unix.
Price: $895.
Contact: Lynx Real-Time Systems, Inc., 16780 Lark Ave., Los Gatos, CA 95030, (408) 354-7770; fax (408) 354-7085.
Circle 1023 on Inquiry Card.

IDB Object Database for Mac and Unix

The IDB Object Database is now available on the Mac, Next workstations, and Hewlett-Packard machines running HP/UX, joining versions for Windows, Sun, and HP/Domain operating systems.

Version 1.1 supports controlled sharing of information across heterogeneous networks with any mix of supported platforms, according to Persistent Data Systems. The program can also store and manipulate complex information.
Price: $2500 for PCs or Macs; $3500 for Next; $6000 for HP/Apollo, HP/UX, or Sun workstations.
Contact: Persistent Data Systems, Inc., 75 West Chapel Ridge Rd., Pittsburgh, PA 15238, (412) 963-1843.
Circle 1024 on Inquiry Card.

Objectworks\C++ Supports Teamwork

Objectworks\C++, ParcPlace Systems' programming environment for C++, now supports team programming and integrates with popular Unix development tools such as `make`. It runs on the Sun-3 and Sparcstation platforms.

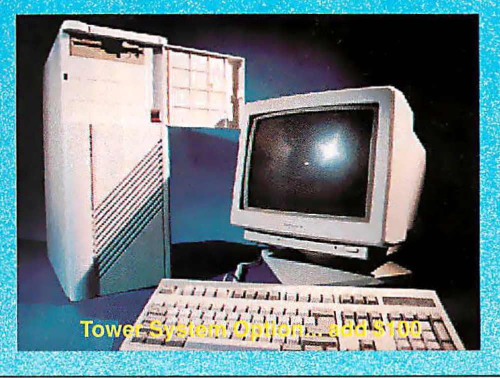
Version 2.4 of the environment is now suited for teams of programmers working on medium to large C++ projects, the company says.
Price: $3000.
Contact: ParcPlace Systems, 1550 Plymouth St., Mountain View, CA 94043, (415) 691-6700; fax (415) 691-6715.
Circle 1021 on Inquiry Card.



486/33 Features

80486 33MHZ 32 bit INTEL CPU
4MB RAM-Expandable to 32MB
AMI BIOS with Extended CMOS Setup
256K Static RAM Cache
8 Expansion Slots (ISA 16 bit)
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220W Switching Power Supply
Serial, Parallel, and Game Ports
MS-DOS 5.0, Serial Mouse included
Full 1 Year Limited Warranty-Parts and Labor

EISA System, 32 bit Bus (EISA has 7 32-bit slots, 1 16-bit slot)	add $1000	336MB ESDI (16ms)	add $1150
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		ESDI/EISA 32-bit Controller	add $795



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512K Super VGA Card
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Desktop Style Case
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Serial, Parallel, and Game Ports
Full 1 Year Limited Warranty-Parts and Labor

386SX/20 **$845.00**
286/12 **$645.00**
386SX/16 **$795.00**

14" SuperVGA, 512K VRAM	add $350
80MB Hard Drive, 19ms	add $100
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Memory Upgrade (per MB)	add $65

MS-DOS 5.0 (with System Purchase Only)	$65
Logitech Mouseman, Serial	$69
Logitech Mouseman, Bus	$79
Logitech Trackman, Serial	$89
Logitech Grayscale Scanman	$315
TEAC 1.2 Floppy	$65
TEAC 1.44 Floppy w/ bracket	$69
Microscience 8040, 42MB IDE HD, 23ms	$235
Conner 30104, 120MB IDE HD, 19ms	$415
120MB Tape Backup	$275
CM7 SuperVGA, 14" (Interlaced at 1024, .28 dot)	$345
CM8 SuperVGA, 14" (Non-Interlaced 1024, .28 dot)	$475
AM9 SuperVGA, 14" (Sony Tube, Non-Intl., .25 dot)	$575



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4MB RAM-Expandable to 32MB
64K Cache-Expandable to 128K
14" SuperVGA Color Monitor, 1024x768
512K Super VGA Card, 1024x768 at 16 colors
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386SX CPU	25MHz	16MHz	20MHz	20MHz	25MHz
Memory	2MB	2MB	2MB	2MB	2MB
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1.44MB FD	Included	Not incl.	Not incl.	Included	Included
Hard Disk	40MB	40MB	40MB	40MB	40MB
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Parallel Port	1	1	1	1	1
Mouse Port	1	1	Not incl.	1	1
Mouse	Included	Not incl.	Not incl.	Included	Included
VGA Card	1MB	Not incl.	512KB	1MB	1MB
VGA Monitor	1024x768	Not incl.	800x600	1024x768	1024x768
MS DOS 5.0	Included	Not incl.	Not incl.	Included	Included
Windows	Included	Not incl.	Not incl.	Included	Included
Price	**$1,595**	$2,895	$2,393	$2,516	$1,825

MODULAR, UPGRADABLE SYSTEMS

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486SX/25......$2,795
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NEWS

WHAT'S NEW • PROGRAMMING

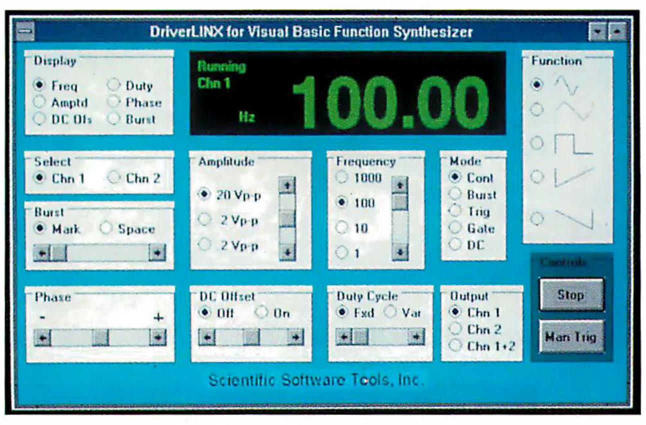
Data Acquisition for Visual Basic

DriverLinx for Visual Basic offers a series of real-time data acquisition engines for third-party, high-speed analog and digital I/O boards. DriverLinx, which takes the form of a custom control that is added to the Visual Basic toolbar, enables you to drop a data acquisition engine into your application. Users can choose from more than 100 functions for creating both foreground and background tasks.

Price: $400.

Contact: Scientific Software Tools, Inc., 30 East Swedesford Rd., Malvern, PA 19355, (215) 889-1354; fax (215) 889-1630.

Circle 1031 on Inquiry Card.



DriverLinx for Visual Basic comes with complete source code for this two-channel function synthesizer to show you how to develop real-time applications.

Nonlinear Modeling in C++

Autodif is a C++ array language extension with automatic differentiation for use in nonlinear modeling and statistics. Derivatives are calculated with the same accuracy achieved by analytical formulas and with minimal overhead.

Price: $99; $149 after April 1.

Contact: Otter Research, Ltd., P.O. Box 265, Station A, Nanaimo, BC, Canada V9R 5K9, (604) 756-0956.

Circle 1033 on Inquiry Card.

Network Routines for BASIC

Patterned after Novell's C Interface, QuickNet consists of more than 250 assembler routines that let you write applications in BASIC that access Novell networks.

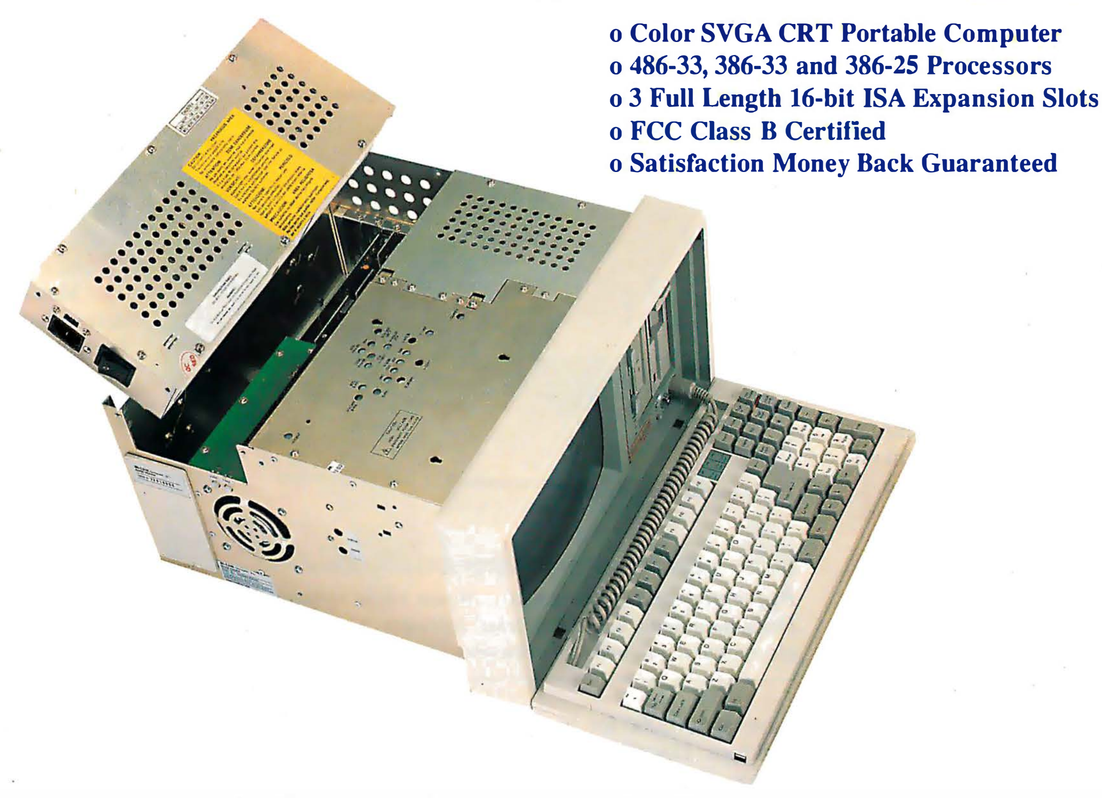
QuickNet works with QuickBasic and version 4.0 and higher of Microsoft's BASIC Compilers.

Price: $199.

Contact: Mirage, 8086 South Yale, Suite 1, Tulsa, OK 74136, (918) 251-8086.

Circle 1032 on Inquiry Card.

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The PORTABLEdesktop models come in a 486-33, 386-33 and 386-25 processor speed. The model PD433 with a 486-33 microprocessor containing a built-in 8 KB cache, MMU and FPU. The MaxiCache and IROS are two schemes exclusively to the PD433.

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PORTABLEworkstation



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Circle 569 on Inquiry Card (RESELLERS: 570).

Document Management for Unix

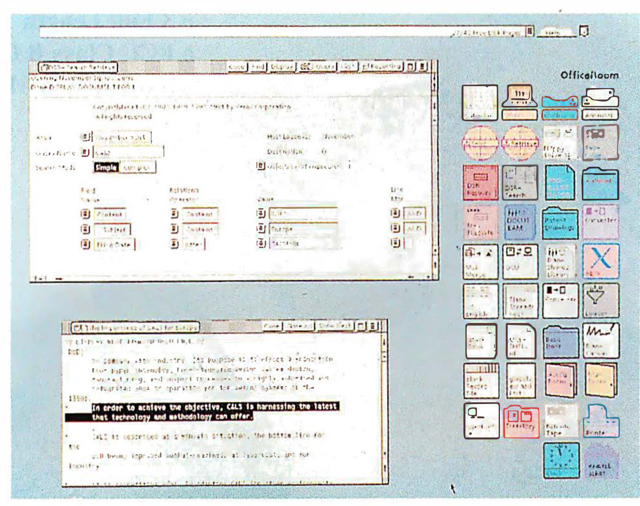
Available for the first time for Unix, the Xerox Document Search and Retrieval (DSR) document management software, DocuTran automated translation software, and DocuTeam workgroup software run on SPARC systems with the Xerox GlobalView networked environment.

DSR combines text management and retrieval to store, retrieve, and view documents. DocuTran translates text from English into French, German, Spanish, Italian, and Portuguese. It also translates German and French into English.

Price: DSR starts at $7000 for five licenses; DocuTeam starts at $20,000 for 10 desktops. DocuTran: host station, $9995; workstations, $2000 each. GlobalView, $1985 per workstation.

Contact: Xerox Corp., P.O. Box 1600, Stamford, CT 06904, (203) 329-8700.

Circle 1034 on Inquiry Card.



By pointing and clicking with a mouse while running Xerox's Document Search and Retrieval software, you can locate electronic documents on networks.

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FEATURES

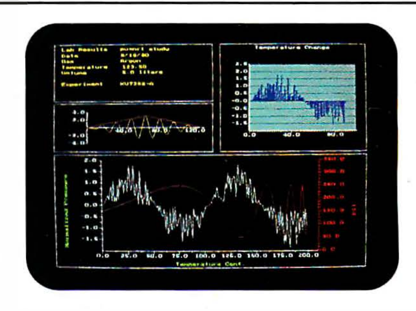
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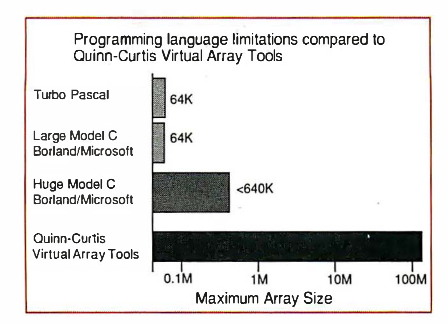


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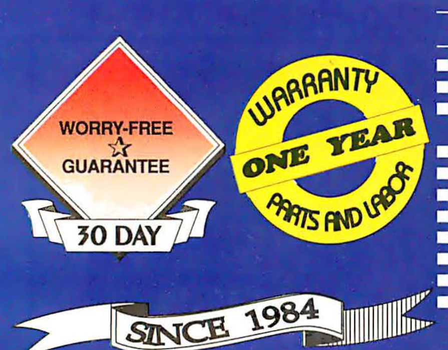
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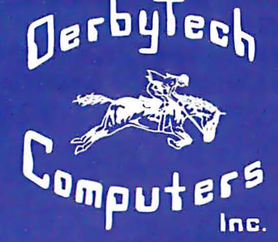
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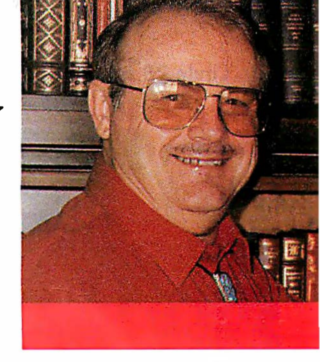
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JERRY POURNELLE

Configuration Tribulations

This month started with a trip to the World Science Fiction Convention, and it ended with a trip to Washington for a visit to the Pentagon as well as attending the tenth anniversary of the founding of High Frontier. While we were there, we dropped by the Smithsonian, where they still have Ezekial, my old CompuPro CP/M system, on display. Between trips, Larry Niven and I nearly finished *The Moat Around Murcheson's Eye*. Meanwhile, stuff poured into Chaos Manor: alas, much of it experimental, or developmental, or simply not worth writing about.

The result is that this will be a rather odd column, opening with some gripes. But hang on, because there is plenty of good stuff I can recommend, and I'll get to that, too.

Setup Programs

If you have a spare day, you might try updating Windows when you are using Quarterdeck's QEMM-386 and Symantec's Norton Desktop for Windows. It will take at least a day; it took me longer.

My apologies if these comments get out of hand: at the moment, I would like to find and beat senseless the designer of the installation programs for both Windows and Norton Desktop. Then I'd like to burn their houses and sow the site with salt. After that, I might calm down.

For the past 12 hours, I have tried to get back to where I was when I started. I finally managed, and thereby hangs a tale.

Warning!!

If you have Windows working properly and decide to update to a new version, save everything: the Windows subdirectory, all subdirectories (particularly SYSTEM) below that, and all your CONFIG.SYS and AUTOEXEC.BAT stuff. But do not save them on the same machine. I mean that literally. Save them on floppy disks, or use LapLink to connect to a different machine entirely and then disconnect the wires between machines. I wouldn't even leave the computer connected to a network.

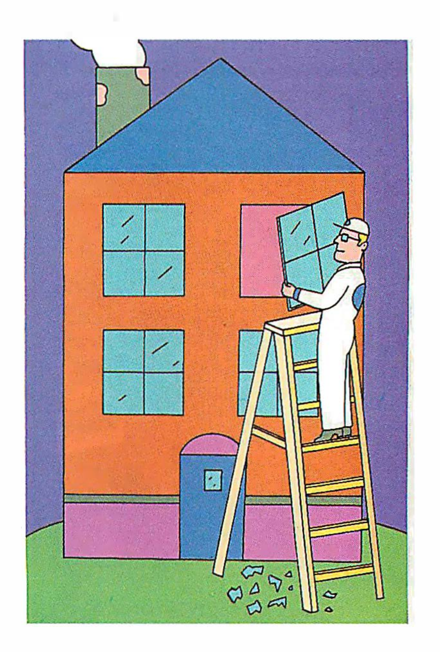
In my case, I transferred the CONFIG.SYS, AUTOEXEC.BAT, and other such files to logical drive D, in a subdirectory called C1. I went on to copy the Windows subdirectory to D\C1\WINDOWS and the Norton Desktop subdirectory over to D\C1\NDW as well. That way, I figured, at worst I could get back to where I started.

Wrong.

The Norton Desktop and Windows Setup programs go off and find *all* the previous copies and do things to them. In addition, Windows Setup makes changes to the SYSTEM.INI and WIN.INI files. Exactly what I don't know; if I had known, I would not have wasted the entire day trying to get back to where I was. All I know is that I had no choice but to plunge onward, because attempts to restore by copying the D\C1 subdirectories to the appropriate places on C didn't help: I was unable to enter Windows at all.

Mixing the latest versions of some software can put you on the "bleeding edge" of technology

There was no help for it: I had to reinstall Windows from scratch. This takes a while, and I didn't do it right at first, so I had to do it several times. Every time I did it, Setup would tell me that I had already installed Windows from those disks, and this was a copyrighted program, and I was probably violating the law.



QEMM-386, EMM386, and Doom

Originally, I had Windows 3.0 and a beta version of QEMM-386 6.0. This was installed by a Quarterdeck technician, and it gave me a lot of system RAM. Windows ran Norton Desktop as a shell, and I had a number of customized icons. I had installed the Icon Paks, I'd used the Norton Icon Editor to customize others, and I had grouped everything nicely. I could run DOS games such as The Lost Admiral and Railroad Tycoon under Windows, and I had nice customized icons for those.

Notice I say *had*. Now I can't run any of those programs, my icons are gone, and my files are ungrouped. In a word, I'll have about 3 hours of work to get back to where I used to be. (Actually, it was more like 5 hours; I wrote parts of this as things happened.)

My problems started when I decided to replace my beta QEMM-386 6.0 with the shipping version. Then I wanted to upgrade to a Windows 3.1 beta version. The upgrade setup seemed to work all right—but when it was



finished, Windows wouldn't work. "Missing some device," the error message said. No clue as to what device, and the system locked up about half the time I booted up.

So I tried to restore from drive D and get back to where I'd been. No joy. After I copied everything back over, I got the exact same error messages. Apparently, the Setup program had gone over to drive D and mucked that up, too. Note that the Mac does that kind of madness all the time. Roberta suggests that Microsoft has hired a bunch of former Apple software designers. Could be.

Roberta stood on one foot like a flamingo while I did the installation of Windows 3.0.

The next thing to do was to erase all that stuff and start over. After all, Norton Desktop would take care of things; or so I foolishly thought. First things first, then: get rid of QEMM-386 and set up with HIMEM.SYS and EMM386.EXE until things are working right. I used the installation program again, noting the infuriating little message about how I had installed from these disks before; and lo!, Windows ran, and Norton Desktop put my old configuration back on-screen. Joy.

Except that most of my applications wouldn't run. There'd be a flash on the screen, something about no ERROR.DAT file, and something about memory. It was too fast to read, so I don't quite know what it said. Just that a bunch of my programs would not run. Eventually I figured it out: they didn't have enough memory.

Oddly enough, I could run Norton Commander—and inside Norton Commander, running under Windows, I could run some of the programs that would not run directly under Windows. Really odd.

Stepping Back

Next thing, then, was to try to make more memory by using QEMM-386 with the updated Windows. No joy. Although QEMM-386 6.0 says that it knows how to make Windows work properly, that isn't true: I can run QWINFIX until doomsday, each time getting the message that all is well, and Windows still won't run. OK, scrub QEMM-386. (I have since learned that QEMM-386 6.0 will work if you start Windows with WIN\D:X.)

Next thing: try 386Max 6.0 from Qualitas. That installs easily, once you get past their obsession with making sure you know about the copyrights—you need the serial number off the box to make it work, and if you throw the box away you're doomed—but then Windows would not work: not enough extended memory. Because my Cheetah 486 has 16 MB of memory, this didn't seem reasonable. It turns out that 386Max defaults to making all your memory into expanded memory, and Windows can't use that. Fortunately, the 386Max documents are clear enough on what to do. I put the notation `EMS=2048` in the CONFIG.SYS line invoking 386Max, and it made 2 MB of expanded memory and 14 MB of extended memory.

Once that was done, the new version of Windows wouldn't work. The error messages, as usual, were completely uninformative. No Windows with 386Max 6.0 or QEMM-386 6.0.

In other words, I could stay with Microsoft's inadequate memory management software so that a lot of my DOS applications wouldn't run under Windows, or I could dump the new version of Windows. There wasn't much choice about that, so I scrubbed everything and went back to Windows 3.0, installing from scratch. I have completely given up on update installations to Windows. Sigh.

Roberta must have become weary of my screaming at the software, because this time, just for luck, she stood on one foot like a flamingo while I did the installation. I asked her why she was doing that. "Why not? It can't hurt," she replied. I recall that when we travel she raises her feet when the airplane takes off: same reason.

Maybe that was it, but the Windows 3.0 installation went very smoothly, and it ran fine. Of course, that was under Microsoft's memory management software, and it produced windows too small for Railroad Tycoon, but at least I had Windows up again. Now to switch to 386Max.

That worked. More than a 600-KB temporary program area, and I was in Windows. Now for the acid test: install *Railroad Tycoon* as a DOS application and try to run it under Windows.

Voilà! Qualitas has come through: there's more than enough memory to run Railroad Tycoon; indeed, I have six different Railroad Tycoon games running at the same time. Wonderful! Now try The Lost Admiral. . . yep, that runs fine, and

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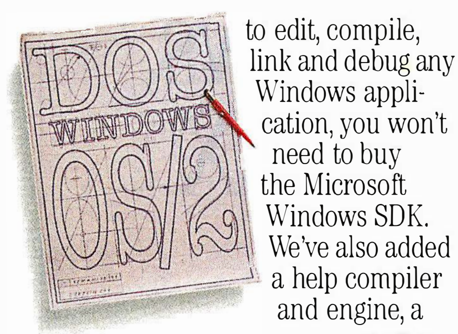
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it will blow up with no explanation if I reset using EMM386.EXE. Joy.

Fortunately, 386Max does everything it should do, and it makes for bigger DOS windows than QEMM-386 6.0 to boot. I like QEMM-386, and if you use Desqview, you ought to use it. But for use with Windows, at least for the moment, it's 386Max for me. It's easy to install (only do remember to adjust expanded memory size) and seems to work flawlessly. Highly recommended.

ATI Graphics Ultra

Clearly, I like Windows; but do understand, I have the hardware to support it. One of those hardware items is the ATI Graphics Ultra video coprocessor and Super VGA board. This thing takes all the sting out of Windows: it's very fast, the resolution is good, and when it isn't doing Windows, it's an excellent Super VGA board. On the big 19-inch Hitachi monitor, you can actually make use of software and modes that put hundreds of lines of text, or spreadsheet boxes, on your screen.

Moreover, the Graphics Ultra is easy enough to install. It comes with a mouse port and its own three-button mouse. Of course, having a mouse bus on the video board saves a slot (or a COM port).

There's lots of software for using the Graphics Ultra with AutoCAD, Ventura Publisher, and so forth. You get Bitstream scalable fonts. Mostly, you get displays that look as if you have a laser printer right there on your screen.

If I had to do much desktop publishing with a PCompatible system, I'd run out and get the Graphics Ultra. The time saved in proof copies would be significant. This board isn't a memory hog, and it has performed wonderfully for every task we've asked of it. I really like it.

Desqview

I run Windows on a Cheetah 486. That's the machine that Larry Niven uses when he comes to work here: it has an older Zenith keyboard, which Larry prefers to my nice new Northgate OmniKey keyboards. It also has the 19-inch Hitachi screen (which Larry can see without his glasses), an ATI superfast video board, and the Perceptive Solutions superfast hard drive controller.

I run Windows on that machine largely because I like to be able to get at Norton Commander without exiting the word processor. Niven and I use "sneakernet" to transfer text files: when he works on a chapter, he saves that onto the hard disk. When it's time for me to see it, the files are transferred to a floppy disk, which I put into my machine, automatically making a backup copy.

If Larry has made changes to several chapters (each chapter is a file in our system), there are several files to be transferred to a floppy disk, and that is accomplished by using Norton Commander. Thus, what I want available on Larry's machine is a task-switching system that will get me from Q&A Write (configured with Word Finder and the Definitions Plus version of *The American Heritage Dictionary* as TSR programs that are available in background) to Norton Commander.

On my own system, I do that with Desqview; but the problem with Desqview is that the hot key is the Alt key, and Larry Niven is perfectly capable of striking that key inadvertently. When he does, Desqview pops up, and it confuses him. We both hate when that happens; and since Windows was doing the job quite nicely, and Niven is exceedingly unlikely to hit Control-Escape, I used Windows for his machine.

That also means that I can play Railroad Tycoon and switch back to either

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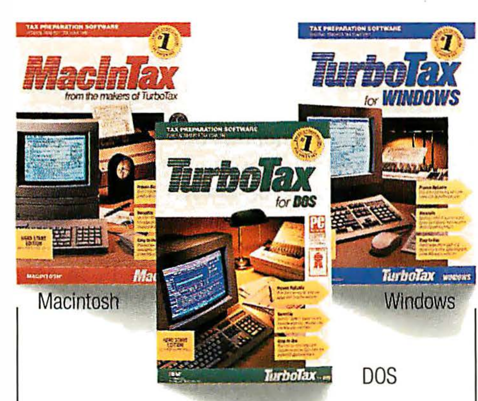
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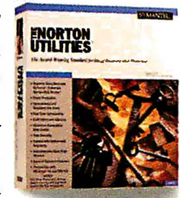
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Q&A, Norton Commander, or to a database (when I play Railroad Tycoon, I tend to be *serious*).

However, my own machine, a Cheetah 386, still has Desqview. I'm used to it; and, indeed, Desqview really is more flexible than Windows, and once you have some experience with it, it's easier to use. Among other things, you can close a Desqview application much more easily than you can get rid of a Windows application; and you can quit Desqview regardless of whether other applications are running.

I suppose over time Windows will replace Desqview. It does have some advantages; but for the moment, I am content to use Desqview—except that once more I have a weird problem to relate.

My Cheetah 386 runs DOS 3.3, and thus my hard drive is partitioned into logical drives C through L. This isn't a real hardship except that sometimes I forget where a file has gone.

I have two large TSR drivers set up with my Cheetah 386: a Hitachi CD-ROM and LANtastic. With LANtastic, I can access the Pioneer Minichanger CD-ROM drive and the Pioneer read/write optical drive that doubles as a WORM; and, of course, I can send stuff to the network server for backup on the Palindrome tape drive, as I described last month. All these assets are available in all Desqview windows, and my windows can be 544 KB in size, which isn't really enough, but it will serve.

However, I keep thinking I ought to have larger windows and that I can get them by switching to DOS 5.0. But whenever I do that, I have much *smaller* Desqview windows. This doesn't make much sense; but I have twice changed to DOS 5.0, and each time I have fished out the DOS 5.0 uninstall disk and gone back to the old system. More when I learn more, because I really do like DOS 5.0. Sigh.

If you do change to Windows, get Norton Desktop.

Norton Desktop for Windows

If you do change to Windows, get Norton Desktop. It makes Windows a lot more fun, as well as easier to work with. There's even an icon editor to let you customize things, and a fast-open panel that's quite nifty for getting things started in a hurry. It does take up a lot of disk space—about 5 MB. I think it's worth it, but then I have a lot of disk space.

One caution: if you update your version of Windows, you may lose all the work you did with Norton Desktop in making things pretty. In theory, you can save things; but in practice, I was not able to do that.

If you do reinstall with the notion of getting some of the saved stuff back, forget it. I saved mine in D\C2\NDW, and the Norton installation program went over there and found it and insisted on working with that no matter how much I told it not to. The designer of that installation program is another prime candidate for mayhem.

Except for the installation program, though, I really like Norton Desktop for Windows, and I think you will, too. Recommended.

More Goodies

Although you don't *need* them for Windows, a few other products make it a great deal more fun. Icon Paks I and II provide all kinds of nifty little icons—balloons, birds, government buildings, trains, tanks, flags, programmer symbols, you name it. After Dark, the famous Flying Toasters screen blanker, will put fish, lightning, and other stuff, including messages, on your screen when you're not using it.

One reason to adopt Windows is that it helps make PCompatible computers fun again. Maybe not quite as much fun as a Mac, but it's getting there. One warning: once you start customizing your icons, it's hard to know where to stop.

And Yet More

One problem with Windows is that the standard fonts are, if not really yucky, at least not very sparkling. The Graphics Ultra board comes with some better fonts, but there aren't enough of them.

There's an easy fix for this: More Fonts gives you scalable typefaces, about as many as you'll ever want, with more coming. They look nice, especially with the Graphics Ultra board. There's a wide variety, from formal to fun, with patterns, outlines, shadows, reverses, and all the other stuff you'd expect. They're easy to install, and they work fast and efficiently. If that's not enough, there's also Display Faces, 26 more typefaces ranging from Geneva to cursive script to Zbats, which are Dingbats for the PC. What more could you want? Recommended.

It's Me, Blast You!

I like MathCAD. It's easier to use than most other math programs, and MathCAD makes it a *lot* easier to create documents that have numbers in them. If you're looking for a present for a computer-using high school or college student—regardless of major—I have no hesitation in recommending this program. I would have killed for it when I was in school.

MathCAD lets you simply muck about with numbers and equations, doing complicated things and getting the right answer. In other words, it lets you get a feel for how mathematics works to describe the world. That's terribly important for any educated person, whether he or she is going to teach English, go into accounting, become a physicist, or just wants to understand the world better. The new version of MathCAD for Windows integrates into the Windows environment nicely, and on a 386 or a 486 with a math chip, it runs so fast you hardly notice the delays.

I'm fond of MathCAD, but this seems to be a month for complaints. When I installed the program, it insisted that I give it my name. All right, that's becoming a common way of trying to control software piracy, and I don't disapprove. Then it wanted a company name.

I'm not a company. I'm just me. Sure, there's a legal entity known as J. E. Pournelle & Associates, but I don't need that splattered over every program I have. So I put in my name and left the company name blank; it wouldn't install. I tried spaces. Same story. I finally typed in BLAST YOU!!, and that worked fine; so now my copy of MathCAD for Windows identifies itself as being used by Jerry Pournelle, BLAST YOU!! Oh, well. MathCAD isn't the only program with silly installation rules. Highly recommended.

Math Blaster Plus

We have a whole slew of new educational software. I generally let Roberta pick

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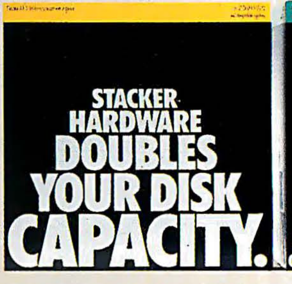
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through that pile to see what she'll recommend. One she likes is Math Blaster Plus for the Mac; this evaluation is based on her notes.

The start-up program is a snap. Enter your name at the prompt, and Blasternaut and his robot Spot invite you to join them in outer space, where ships race across the sky. The program is built around four adventure games. The graphics are neat, even on the tiny Mac SE screen.

The 750 math facts cover most elementary school arithmetic facts, from addition through percentages. The program is far from perfect. The error loops aren't as well thought out as we'd like, and sometimes it will tell you that you got a perfect score when you didn't. You'll always reach the Hall of Fame no matter how lousy you do.

However, Math Blaster Plus does make flash-card drill more palatable. There's an editor, so a teacher or parent can customize the drills to concentrate on areas where more work is needed. Probably nothing is going to make math drill really fun, but this gets closer than most methods. If you have a Mac and a child in the relevant grades, this will likely do some good.

Disney World

For best results with Disney software, first buy the Disney Sound Source. This is a little speaker that plugs into your PC-compatible's printer port (you can do this while your printer is still active; install Sound Source and forget it). It didn't come with any software, so its only use seems to be to run Disney software, but that's quite enough reason to have one.

One Disney program is Mickey's ABC's: A Day at the Fair. It comes in living color with music and speech. Roberta says: "The ABC program is recommended for preschool kids ages 2 to 5. Installation takes only three steps. Beware of the copy-protection scheme. The adult installing the software needs to match up a black drawing of Mickey in a particular pose on brown paper with a cartoon cell on the screen. The black drawing is almost impossible to see on the very deep brown paper. Don't give up on this, because the part designed for the kids is worth it."

In fact, she says a lot more, all enthusiastic. The program is self-prompting: if you do nothing, a female voice gives you directions. Then Mickey talks to you, leads you around the house, and generally does things in response to your typing in letters. This is about as painless a way to learn the alphabet as you'll find.

Roberta continues: "Pressing a letter can initiate different actions depending on Mickey's location. Press the uppercase or lowercase *F*, and Mickey slides down a firepole in his bedroom floor (every boy's dream) and he's off to the fair. He meets different animals at the fair and competes with Donald Duck. Donald or Mickey wins the contest depending on the sequence, and Goofy shoots the starting gun, which presents the word *bang*, like in a vaudeville scene. After the contest, Goofy presents the prize ribbon." And so forth.

The cartoons are Disney quality, the voices are true to the characters, and the various actions you get from pressing different letters are fun to watch. All told, it's another painless way to get kids to do alphabet drills.

Roberta, who has taught about 15,000 people to read, sums it up this way: "This software is a step in the right direction and would probably have enough variety to keep most children's interest at that age. No software designed for this age group will last very long. Learning that letters have sounds is the first step in learning to read. This software can help you explore

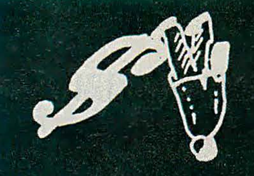
GO

Imported EISA board has no tech support

START OVER

Discount board has compatibility problems

GO BACK 1 SPACE



START HERE

Cheap EISA products force bankruptcy

NOBODY WILL VISIT YOU HERE

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Discount boards not worth the savings

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GO BACK 1 SPACE

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MOVE AHEAD 2 SPACES

Slow SCSI interface ruins reputation

GO BACK 3 SPACES

GO TO BANKRUPTCY

Discount EISA boards have high failure rate

GO BACK 3 SPACES

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Mickey's ABC's: A Day at the Fair.......................................$39.95
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The Lost Admiral.................$59.95
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the sound/symbol connection requisite to learning to read. Highly recommended."

The Literacy Connection

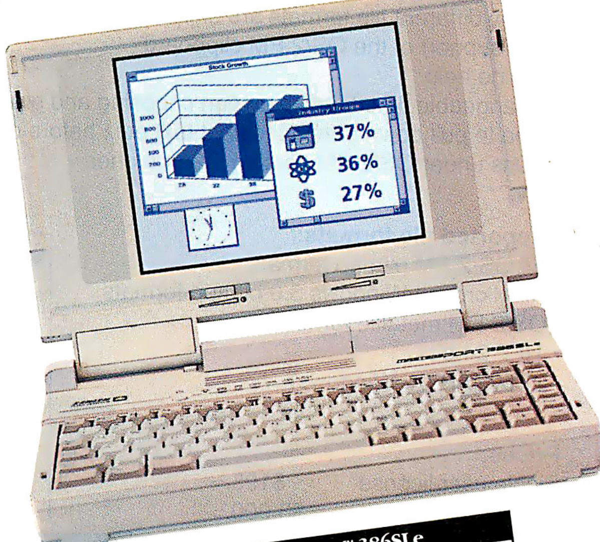
You're probably tired of my mentioning it, but Roberta's reading program, known as The Literacy Connection, continues to get results in field tests. She's got it in half a dozen schools now. Teaching reading is tricky, because a lot of kids—between 25 percent and 33 percent—are "natural readers" who pretty well learn without instruction. Another 25 percent or so will learn quickly and easily. The rest have problems, and the worse the problem, the more important it is to be systematic about reading instruction. Unfortunately, given today's classroom problems, being systematic is precisely what many teachers cannot do.

Roberta's program proceeds systematically. It has 70 lessons. Most children don't need them all. Somewhere around lesson 35, they take off on their own—which is, after all, what you want to happen. We've never heard of anyone who got through all 70 lessons and was still unable to read. But then when Roberta was the teacher of last resort in the L.A. Juvenile Justice system, she got plenty of "hopeless cases" and never failed to teach any of them, either.

Winding Down

The big problem with CD-ROMs is that the access/retrieval software isn't up to

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Circle 187 on Inquiry Card.

the technology. However, I recently received a disk from Aries Systems that demonstrates their Knowledge Finder software; this one is for a very large medical-reference text database. Knowledge Finder is neat stuff, and if you're contemplating making a CD-ROM, you will want to look into it.

The CD-ROM of the month is Magazine Rack, which is published by Information Access (355 Lakeside Dr., Foster City, CA 94404, (800) 227-8431 or (510) 378-5000) and is available from the Bureau of Electronic Publishing. It includes about 100,000 articles from 300 different publications, indexed to make things fairly easy to find.

While I'm at it, Meckler (11 Ferry Lane W, Westport, CT 06880, (203) 226-6967) has a book that if you need it, you need it bad: *CD-ROM Research Collections, An Evaluative Guide* by Pat Ensor (1991, ISBN 0-88736-779-8). This lists nearly every known CD-ROM database—and there are a lot of them—along with addresses, prices (if known), equipment requirements, and some comments on usefulness. It covers everything from chemicals to sports to psychiatry collections.

The book of the month is Lois MacMaster Bujold's *The Warrior's Apprentice*, action adventure science fiction of the old school. The woman can write.

The game of the month is The Lost Admiral. It has some flaws and probably is the silliest role-playing game I have ever seen, but as a game it grows on you. The game mechanics are simple enough to learn, even from the wretched documentation. This is a game, not a simulation, but most of the principles of naval war can be applied.

Of course, if you want modern naval realism, get Harpoon. It has some new scenarios.

All told, a good month, and I learned something: you can install Windows with no trouble at all, provided that your Very Significant Other doesn't mind standing on one foot like a flamingo. . . . ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerryp."

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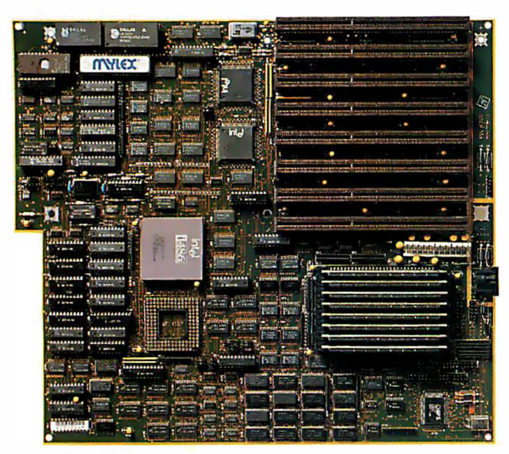
The Power Of Choice.

Prices are MSRP, dealer prices may vary. Awards: Notebook Of The Year, *PC LapTop*, December 1991; VIP, *Portable Office*, November 1991; Analyst's Choice, *PC Week*, April 1991; Best Buy, *PC Magazine* (British Edition), April 1991.
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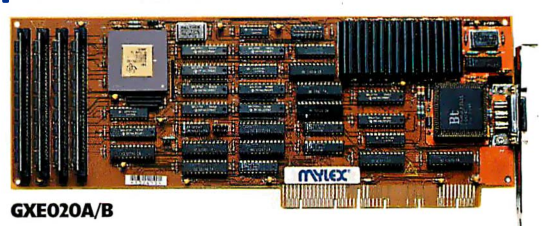
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High-Performance EISA486 System Board
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Graphics Controllers



GXE020A/B

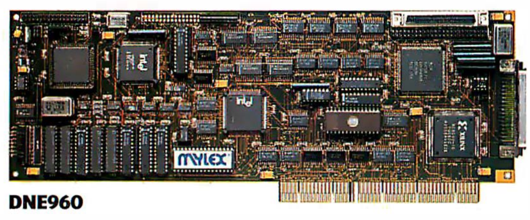
High-Resolution EISA Graphics Controllers
- TI 34020 32/40MHz graphics processor
- 1600 x 1200 or 1280 x 1024 resolution, 8 bit, 256 colors
- TIGA 2.05, Windows 3.0, AutoCAD, X-Window support



GLE9II

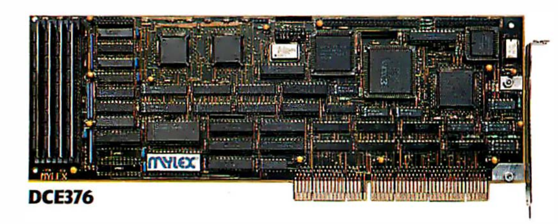
Fast EISA Graphics Accelerator
- S3 graphics accelerator
- 1280 x 960 x 16 or 1024 x 768 x 256 resolution
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SCSI Host Adapters



DNE960

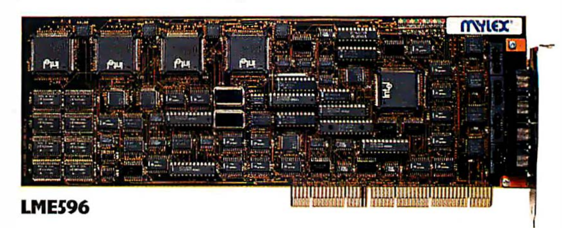
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- EISA bus-master transfer rates up to 33MB/s
- Support for all popular SCSI devices
- Disconnect/reconnect, scatter/gather, synchronous drive support, disk mirroring and duplexing
- DOS, OS/2, UNIX, NetWare support



DCE376

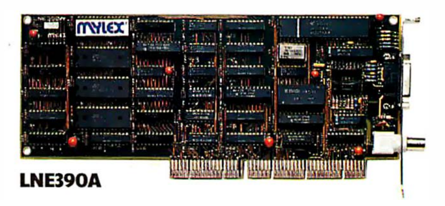
EISA Caching SCSI Host Adapter
- Intel 80376, up to 8MB cache, bus-master transfer rate up to 25MB/s
- Disconnect/reconnect, scatter/gather, mirroring, duplexing, tape backup
- DOS, OS/2, UNIX, SCO UNIX, NetWare, Windows 3.0

Ethernet LAN Adapters



LME596

Multi-Channel EISA Ethernet LAN Adapter
- Four 10Base-T Ethernet ports
- Four Intel 82596 32-bit Network Interface Controllers (NIC)
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- Supports Novell NetWare 3.11, UNIX TCP/IP and NDIS



LNE390A

EISA Ethernet LAN Adapter
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- EISA shared-memory up to 16MB/s
- Novell certified
- NetWare v2.15, 2.2, 3.0, 3.1 and 3.11, UNIX, OS/2 LAN Manager

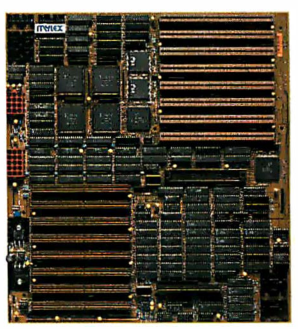
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Multiprocessing System

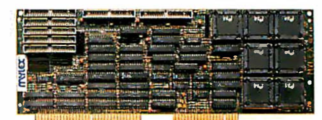
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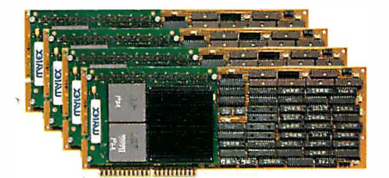
EISA Bus Interface Backplane



Multiprocessor Interrupt Controller



ECC Memory Controller

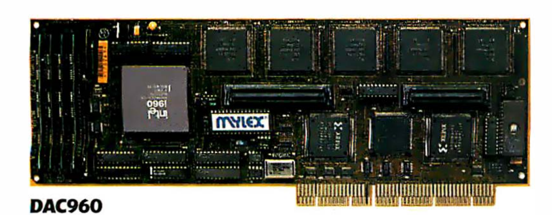


CPU Board

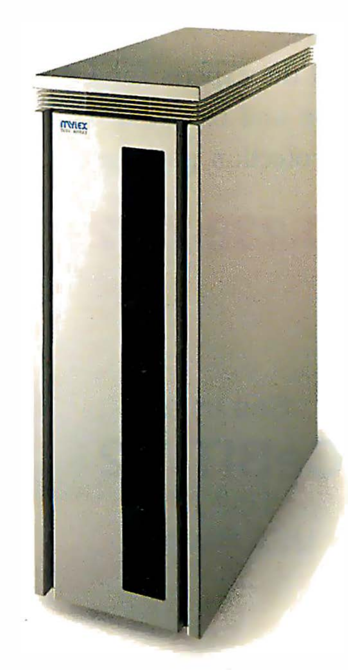
Disk Array Subsystem (Multi-Channel)

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- Up to 64MB of write-back cache provided
- Striping with built-in support for various RAID levels
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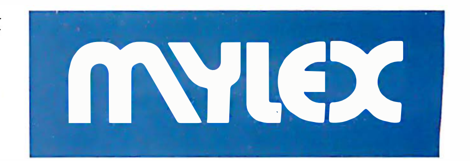


DAC960



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For more information on these or any Mylex products, please contact us at 1-800-77-MYLEX or 1-510-796-6100. Or, fax the domestic sales department at 1-510-745-8016 and international sales at 1-510-745-7521.



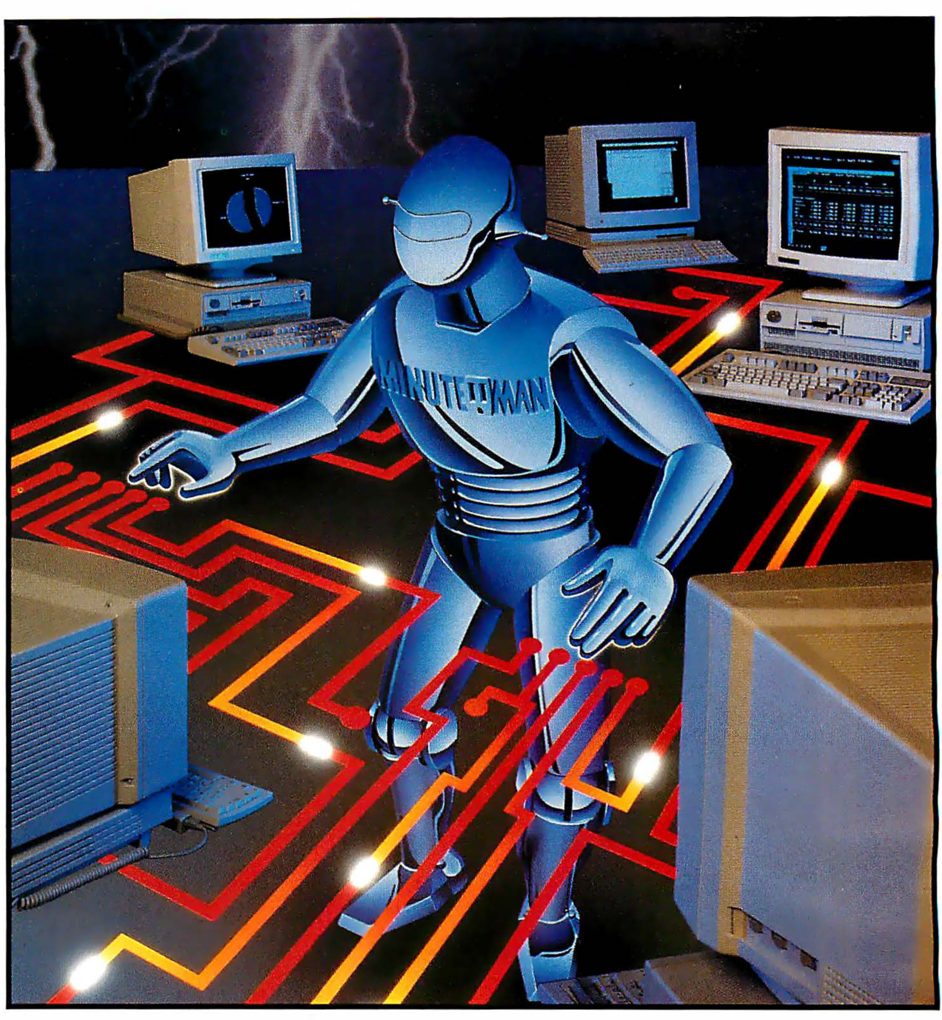
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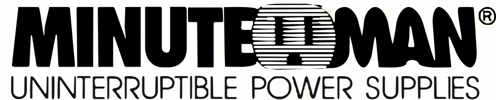
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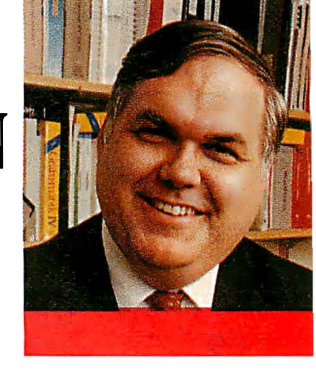




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WAYNE RASH JR.

MURPHY'S LAW AND INTEROPERABILITY

Many people in the computer industry have a deep and abiding interest in Murphy's Law. They firmly believe that when you examine something up close, much of it doesn't work. These people are pessimists, of course. Unfortunately, they're frequently right.

For those of us who have had to deal with moving complex information between platforms, it's clear that the person who first wrote "interoperable systems won't" knew what he was talking about. For years, interoperability was an unrealized dream, and so-called compatible hardware and software packages frequently weren't.

Times have changed. It's now possible to find implementations of popular PC programs for a variety of computer systems. You can use the same spreadsheet package on your Mac, your DOS PC, and your Unix system. You can process your prose on the same word processing program, whether you're using a PC, a Mac, or even a VAX. No longer do you have to worry about finding ways to convert files. After all, you're using the same package on different systems. Or are you?

Defining "Compatible"

One of the best ways to ensure software compatibility between systems would seem to be to use the same applications software across platforms. Using WordPerfect on your DOS, OS/2, Mac, and Unix personal computers and on your DEC, Data General, and IBM host systems should guarantee common access to any word processing file from any machine. That's true, but using the same software on all platforms doesn't necessarily ensure total interoperability. The problem is that there are several levels of compatibility.

The ability to transfer files between two word processing packages means only that you don't need to retype the document text. You probably won't be able to preserve any special characters, formatting commands, or other attributes, although in some cases a word processor from one vendor, for example, will recognize some or all file attributes of another.

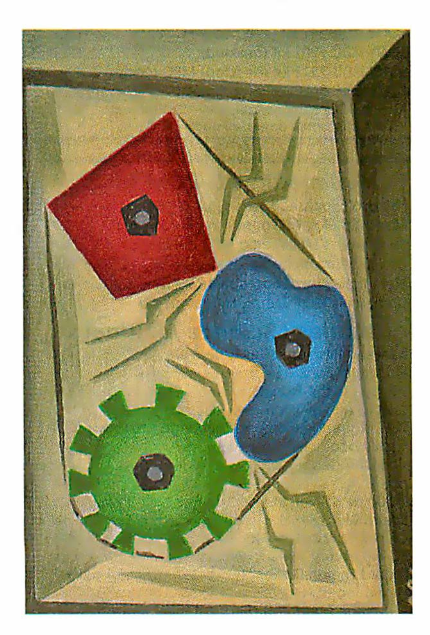
Applications that run on several platforms may support all file attributes across all systems. Often, however, the different versions are out of sync. That means that features available to PC users may not yet be available to Mac or Unix clients, or vice versa.

Still other packages have incompatible file formats, and nothing you can do short of custom programming will allow you to exchange data between them. You might find yourself in this situation if you try to exchange data between a financial package running on an IBM mainframe and a DOS word processor.

Work-Flow Changes

The reason that there's something of a gap between the way applications treat foreign files and the way users want them treated has a lot to do with apparent differences between the way users work in groups and the way applications developers write applications. When people work in teams—project teams, departments, hierarchies, or whatever—they normally share responsibility for the ultimate work product. They may, for example, parcel out sections of a report-writing project and then assemble the sections for final editing. Other companies delegate the initial work on a project to a junior member, who then passes it to others who edit, add material, or otherwise change it.

Sharing files among the many systems and applications in today's office inevitably leads to confusion



Once the initial writing for a product is complete, it passes to final production, where it gets a final scrub for formatting changes, minor corrections, and layout before taking its final form. So the document, spreadsheet, or other work file passes through many hands before it shows up in finished form. Until recently, most office workers performed these functions on paper, and a secretary did most of the work. Now, with the popularity of heterogeneous LANs, electronic versions of a document pass among many users who are often on different systems and running different application programs. The file changes its form many times as it passes through this process. Often, something gets lost in the shuffle.

Common Denominators

LANs make exchanging files very easy. That's why it is so important for applications to handle conversions

transparently. Unfortunately, the process usually isn't transparent. Often, complete conversions aren't possible, and you may have to settle for conversions to and from ASCII as the least common denominator.

Most applications can convert files to and from ASCII. You might, for example, convert a Microsoft Excel spreadsheet to ASCII in order to import it into a WordStar document. You retain the numbers but lose special characters, formatting, and formulas. Even ASCII doesn't always work as an intermediary, because some programs still don't support it. In that case, you'll need a conversion utility to serve as an intermediary. It's unfortunate that a file must pass through all those permutations just so you can get a plain text copy.

Fortunately, there is life beyond ASCII. For example, Lotus 1-2-3 can read dBase files, and Excel can read Lotus 1-2-3 files. The program importing the file converts it directly into the native file format. This works better than converting to ASCII, but you still usually lose some attributes. There are exceptions: Excel, for example, can interpret formulas and other attributes from Lotus 1-2-3 and a few other spreadsheet file formats.

Some developers design their packages to work with other programs. When I wrote my recent book *WordPerfect Office 3.0: The Basics* (John Wiley & Sons, 1991), I sent WordPerfect 5.1 files to the publisher, who used PageMaker for the page layout. The typesetting equipment accepted the text from PageMaker but rejected the embedded WordPerfect graphics-format illustrations. I had to use Inset Systems' HiJaak to convert these images to TIFF.

In such a vast wilderness of file formats, you'd think that the best salvation would be to use the same software on all the computers at your business. If you're using WordPerfect on your IBM clones, for example, perhaps you should use WordPerfect on your Macs and your VAX as well. Then you'd be able to move documents around with no problems of any kind whatever. Right? Not quite.

The Big Iron

Differences between platforms become more noticeable when you move into the world of minicomputers and mainframes. Companies like Lotus and WordPerfect also make software for larger computers outside of the personal computer market. WordPerfect got its start writing word processing software for Data General minicomputers. Regardless of their background, though, differences between software versions remain.

You can create a WordPerfect file on your personal computer that you can't use with the version of WordPerfect that's running on your VAX down the hall. Why? Because the versions for the minicomputer and mainframe worlds tend to lag behind the personal computer versions. WordPerfect 5.1 for the PC was out months before VAX customers using version 5.0 received their upgrade. The spread between WordPerfect versions for some versions of Unix is even wider, so choosing WordPerfect for a corporate standard may still require file conversion.

Some companies respond by ignoring the problem, but most companies can't do that. Others plan to convert everyone to one system. Unfortunately, many companies have such a large investment in the central computer and its attendant terminals that conversion to personal computers proceeds slowly. It's not at all unusual to find workgroups in which some users have computers while others are still using dumb terminals. For these groups to work

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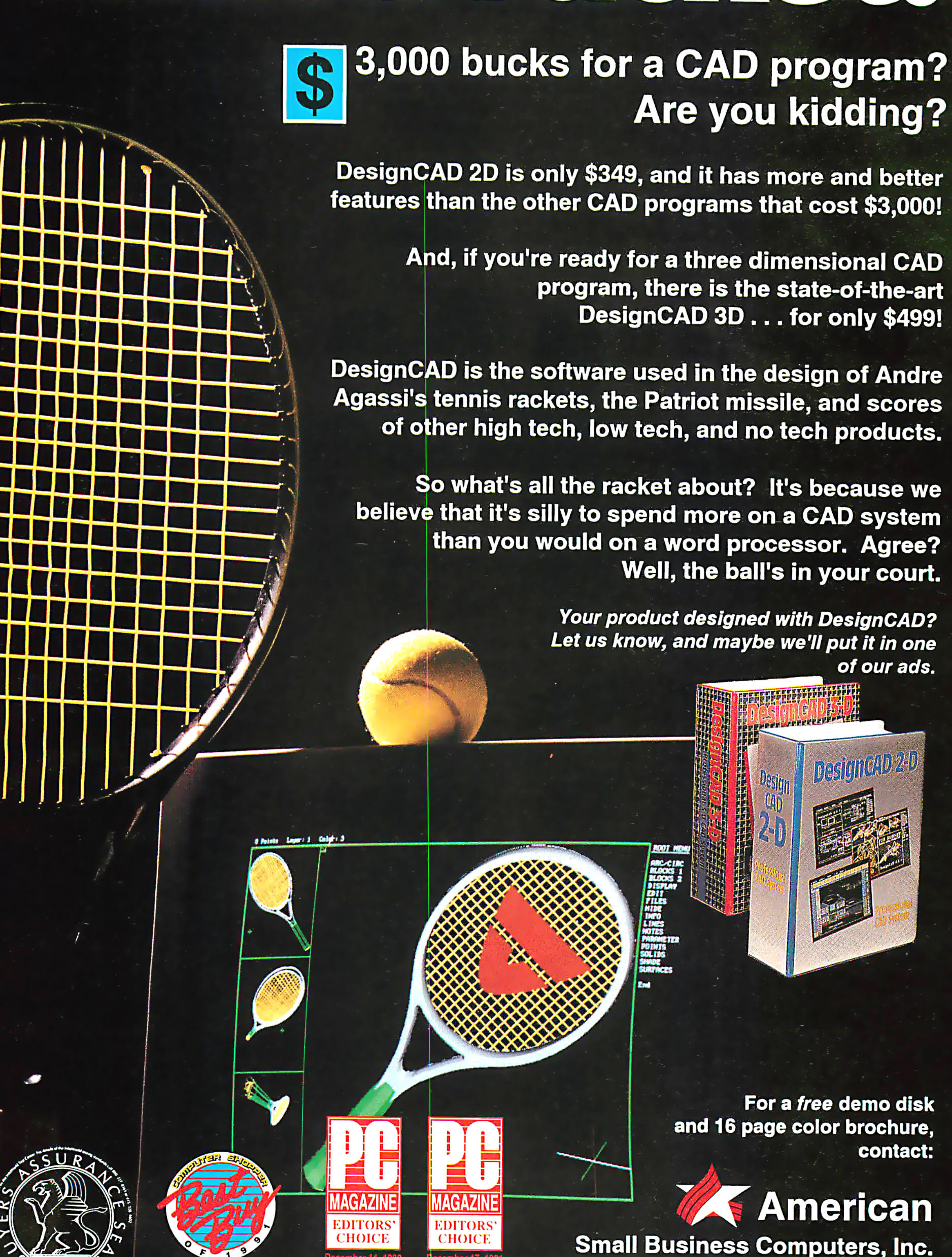
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together, they must share information bidirectionally. What should be a simple task, such as sending a page of text from one user to another, may require a file conversion, a file transfer, or even an upload to the host system, followed by a file conversion. For the process to be useful, it needs to work effectively. Often it doesn't.

What's the bottom line? There's no way to be certain that you can use the same software on multiple platforms transparently unless you can find someone who has done it already. About the only thing you can assume is that there will be glitches, but hopefully minor ones, from time to time.

Coping with the Confusion

Clearly, you'll find no magic solution if you're dealing with users and workgroups that must work together yet have evolved with their own unique systems and applications. But that should be no surprise by now. What you can do is manage the situation by recognizing these limitations and restructuring your work flow and the resources you use to avoid them. You have three basic choices. Your approach depends on your business situation, your corporate culture, and your current investment in hardware.

Solution 1: You can simplify your situation by restricting everyone's choice of computers and software and by replacing those systems that don't fit. If everyone has DOS PCs running WordPerfect, Lotus 1-2-3, and PageMaker, you won't have any problems. This solution avoids compatibility and file-conversion problems and minimizes training and upgrade procedures. It's a bit rigid, though, and can get quite expensive if you have to replace much of your computer equipment. It might also make some operations in the work-flow process less efficient: Mac users in the production department won't enjoy learning to use a PC. Nevertheless, a company that depends heavily on moving documents from one user to another may find compatibility to be more important than flexibility.

Solution 2: Let each user retain his or her chosen system but choose software for each platform that's interoperable with your other applications. This more relaxed approach is more suitable to the way many businesses work. You might select Microsoft Word as your word processor and Excel as your spreadsheet if your workgroups consist of Macs and PCs running Windows 3.1, for example. This works well only if the applications you need are available on all your systems. Be prepared, however, for unforeseen difficulties. You'll maintain workgroup efficiency, but you

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may still lose some flexibility as files pass between groups.

Solution 3: Go for total flexibility. Allow users on each platform to use the best possible application for their task, and live with the limitations. You'll have to accept the fact that moving information between platforms might be a cumbersome process, and you'll have to be willing to live without some file attributes that simply aren't recognized by other applications further down in the work-flow process.

You might, for example, end up with software that can read the data format of another application, or you might select conversion software—such as HiJaak—that will perform such conversions for you. If you don't move many files, don't transfer much data between groups, or don't need a lot of nontransferable file attributes, this approach makes sense.

What's Ahead

There was once a time when data compatibility wasn't a problem. People transferred their documents on paper. If they had to move information in electronic form, they did so by modem or by passing along a floppy disk. Now, word processing documents, spreadsheets, and graphics files are immediately accessible to everyone on a network. Work flow is now an electronic process, and file compatibility is a big issue.

WordPerfect and other vendors are rushing versions of their packages for Mac, DOS, Windows, and Unix users to market. They're not, however, rushing to support other vendors' file formats or to develop a better intermediate file format. Why isn't there a better least common denominator for file interchange than ASCII? The reasons lie partly in the difficulty of determining such a standard, partly in selfish marketing concerns, and partly in a lingering vendor ignorance of how computer networks have changed the work-flow process. Why encourage a customer to buy anything but your product? Ultimately, products that attempt to lock in users in this way will find themselves locked out of tomorrow's LANs.

The more egregious file compatibility problems should be solved soon. There's no good reason for Mac, Unix, and Windows versions of the same word processing program to have problems exchanging data. And users shouldn't have to go through an arcane conversion process in order to read common file formats such as ASCII.

Today's software manufacturers are much better at allowing users to move their information between platforms, but they have a long way to go before file exchange between applications becomes transparent. Until the industry gets there, you'll have to balance the desires of your employees against the efficiency of moving information around and against the flexibility you need to match computing resources to needs. ■

Wayne Rash Jr. is a contributing editor for BYTE and a principal and technical director of the Network Integration Group of American Management Systems, Inc. (Arlington, VA). He is coauthor of two books for business network users: The Executive Guide to Local Area Networks *and* The Novell Connection. *You can contact him on BIX as "waynerash," or in the to.wayne conference.*

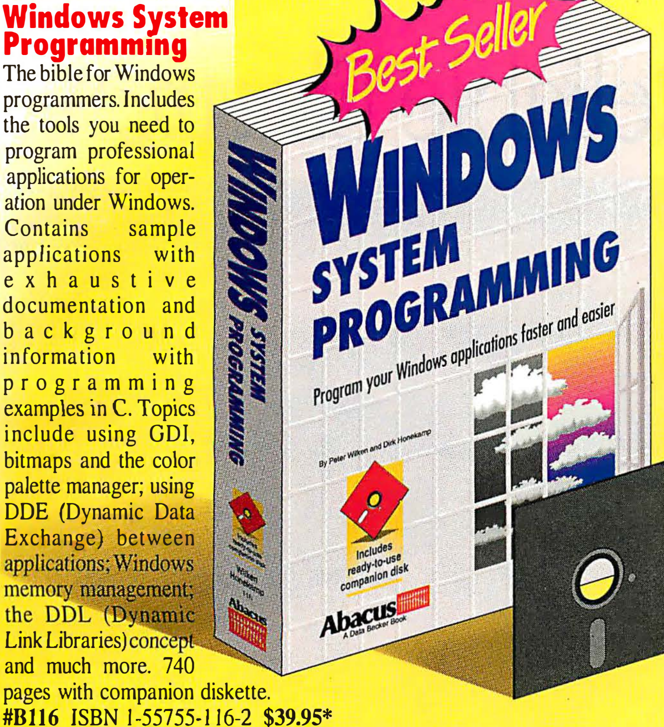
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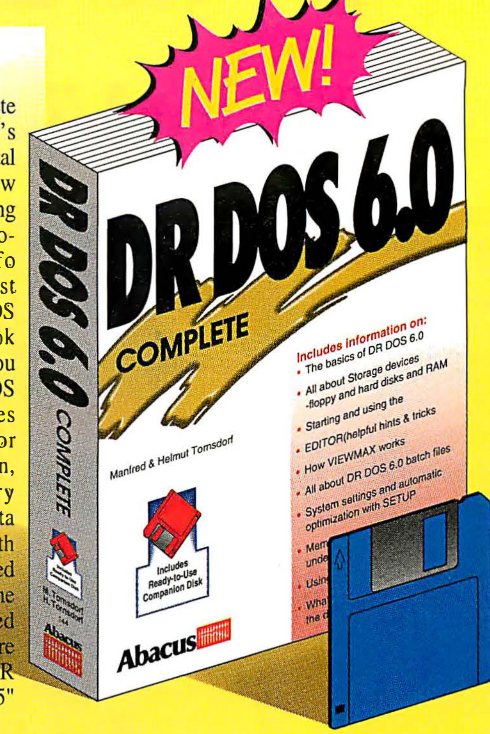
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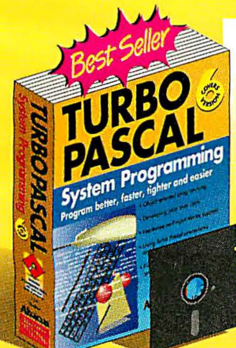
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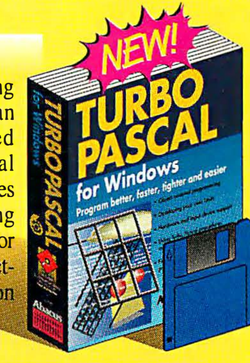


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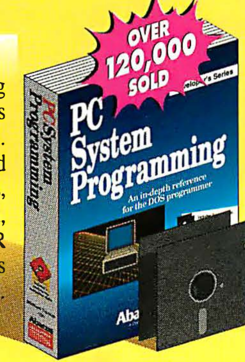
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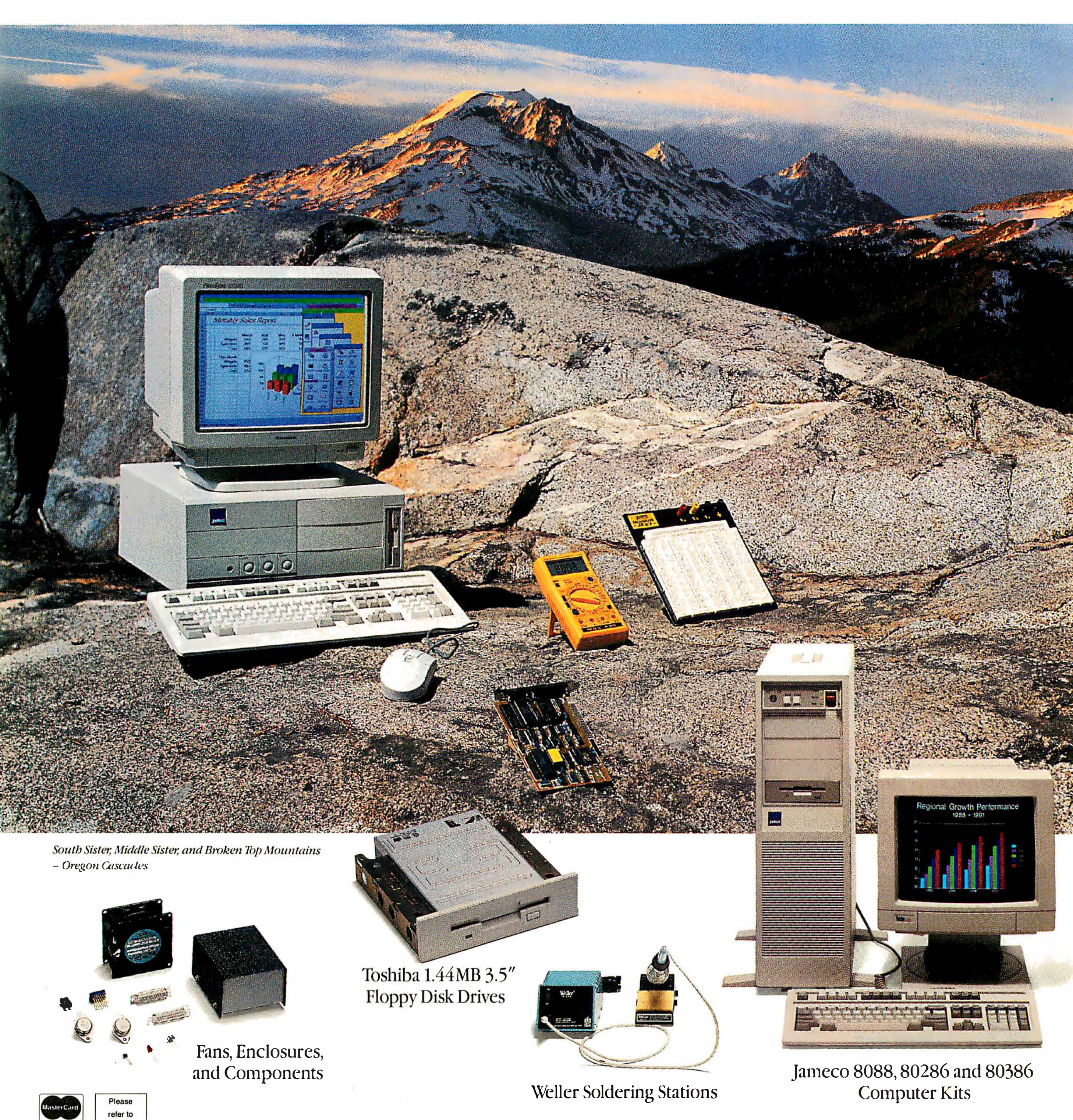
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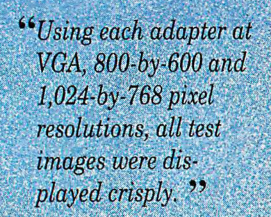
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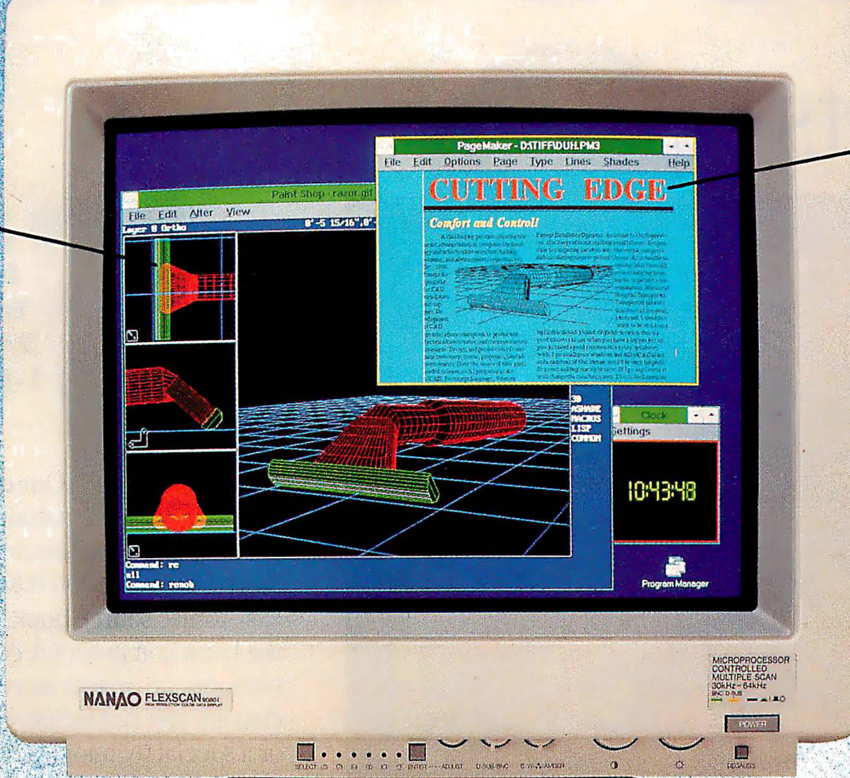
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BYTE columnists, staff, and contributors debate the issues

What Do Benchmarks Really Tell You?

Roundtable is a forum in which BYTE editors, columnists, and contributors debate key issues that affect how you purchase and use hardware and software. The "conversations" take place on BIX, where you can participate in the round.table conference.

KEN SHELDON: Benchmarks: You can't live with 'em, and you can't live without 'em. Or can you?

BYTE spends much time and effort making sure that its benchmarks are fair, are sensible, and produce meaningful results. It takes a lot of work and isn't a lot of fun; anyone who dares release a suite of benchmarks is almost begging the world to take potshots at their efforts.

Some companies optimize their products specifically so that they'll get good ratings on benchmarks. And with the rapid rate of technological advance, today's benchmarks are outdated tomorrow. In view of that, does benchmarking make sense?

DENNIS ALLEN: Let me start by clarifying what benchmarks and benchmark tests are. A benchmark is nothing more than a standard used for comparison. A benchmark test, on the other hand, is a test or a suite of tests that provides measurable results that you can compare back to the original benchmark. For example, the BYTE low-level benchmarks tell you precisely how fast a system performs discrete functions that exercise the CPU, memory, video, and hard drive subsystems. BYTE's DOS application benchmark suite consists of a variety of popular application programs that exercise the system as a whole. By comparing the test results from, say, a notebook PC to the test results of BYTE's IBM AT benchmark system, you can gauge its relative performance.

How important is that? Assuming that performance is a critical issue for the work you do on your computer, those benchmark test results are invaluable. They provide an insight to the type of performance you can expect on a given system. Other considerations depend mostly on the applications you run. But benchmark tests provide a meaningful starting place for evaluating systems.

BEN SMITH: Benchmarks invaluable? Piffle! The only true evaluation of performance is to actually run the applications that you intend to use in the environment in which you intend to use them with the data that you will be handling. The value of a benchmark is determined by how closely the benchmarking method approximates your actual needs.

STAN DIEHL: Benchmarks give you objective data to cite when talking about performance. I put more stock in the product rating of a reviewer who runs a specific suite of tests than that of a reviewer who merely runs a few applications and concludes that "the system seemed kind of pokey under Windows." A good benchmark will consistently expose poor performers and reward the good ones.

We recently tested a 486 system that consistently returned abnormally poor benchmark results. The vendor finally admitted that it was using a 16-bit data path between the CPU and memory. It helped to have hard, tangible numbers to back up our assertion that the machine ran like a dog.

SMITH: I'm not saying that benchmarks are without value; just that they can be misleading if you don't know what they represent. Indexes force the confusion onto the reader. And even knowing this, I will often refer to an index as an indicator of a system's performance. Why? Because it is convenient; not because it is informative.

TREVOR MARSHALL: No single performance index is useful, but I use benchmarking daily to judge performance improvements in the systems I'm designing. Say an engineer comes to me and says, "I have this neat idea for improving our RAM interface." My reaction is to try and identify how much better it is than the current technique. The only way to do this is to use benchmarks.

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Having an adequate repertoire of tests and knowing which tests are likely to detect the changes you've made is the art of a good systems designer.

ROB MITCHELL: BYTE's low-level and DOS application benchmark indexes show the reader the tip of the iceberg. The graphical presentation of index numbers gives only a general impression of how a machine has performed. The BYTE Lab goes over the raw benchmark numbers to pick up any unusual events, such as particularly slow doubleword moves, that need mention. In some cases, above-average performance on one set of tests will compensate for below-par performance in another category. That means that two computers with similar CPU indexes, for example, might not truly perform similarly. We always try to point these things out in a review.

MICHAEL NADEAU: The benchmark tests do no more than indicate whether a machine is fast enough for a given task. The problem lies in how benchmarks are represented, and both purveyors of benchmarks and system vendors share the blame. Benchmark graphs provide nice visuals, but magazines should explain how to interpret them; that doesn't always happen.

Vendors promote good benchmark scores heavily, sometimes to the exclusion of other selling points. This creates the impression in some buyers' minds that benchmarks are the most important purchasing factor.

JERRY POURNELLE: The problem with benchmarks is that it is often possible to work around them. If you know enough about the benchmark, you can design to it; and that has been done, since getting a high score on benchmarks has, in the past, been worth considerable prestige and, thus, money in this competitive business.

Years ago, I devised what I called "a benchmark of sorts" that consisted of generating some matrices, their floating-point multiplication, and then the floating-point summation of the elements of the answer. I generated the matrices by taking reciprocals of numbers, thus making for considerable division. That, at least, had both integer and floating-point loops and numerical calculations, meaning that it would be hard to design to that test and not produce a useful machine. It wasn't perfect, but it seemed better at the time than most benchmarks I knew then.

Not long ago, I heard a tale of horror about how, if you know what you are doing, you can make a crippled machine score as well on one famous magazine's benchmark set as another machine that's not crippled will perform. Even today, benchmarks can indicate only one data point in comparing systems.

MARSHALL: The ultimate benchmark is real life, but whose life? A scientist would be a fool to look at benchmark tests constructed to show spreadsheet performance. He or she needs data on arithmetic speed and accuracy. No one set of benchmarks can cover all cases.

This is the failing with SPEC, but there are many other benchmark suites out there that give potential purchasers some idea of what they're getting. Knowing which to use is still an art form.

Graphics benchmarks are even worse, but heaven knows we need them. How do you benchmark the performance of the X Window System, for instance? And what about the Windows accelerators that everybody is talking about? How much faster are they in real life? You could just say, "Well, the accelerator from company X looks a lot faster when running the Turbo Pascal editor," or you could construct benchmarks to give a quantitative assessment. I prefer the latter approach.

NADEAU: SPEC is not perfect, but it is effective for providing a quick-and-dirty performance ranking of workstations.

MARSHALL: SPEC is good for workstation comparisons but was designed only for Unix systems. You also have to assign at least two programmer-months to compile and run them all, and you need to assign your in-house compiler group to the continuing task of optimizing your compilers for a better SPECmark. (Remember when a recent software upgrade gave IBM a huge boost in its RISC System/6000 SPECmark?) Both these investments are beyond what smaller computer manufacturers can afford.

ANDY REINHARDT: The RISC System/6000's performance boost didn't represent an increase in CPU power, but if a company can achieve a performance increase by introducing a new FORTRAN compiler (whose benefits would also accrue to any other program recompiled with it), that represents a fair and legitimate expression of system performance. The importance of a good optimizing compiler in RISC systems—especially ones with the parallelism of the RISC System/6000—is paramount. It's not a sleight of hand.

MARSHALL: I am a skeptic. I know that the fastest compilers are designed specifically to recognize the code constructs that Dhrystones and Whetstones benchmarks use. Those changes may not affect the code that you or I write.

REINHARDT: I would like to see a price/performance rating in which the cumulative score on the BYTE high-level benchmark tests is divided into the price of the review system, as configured for the test. The end result would be to show which systems provide not just the best performance but also the most for your money. This raises all kinds of problems, though—among them the issues of "suggested list price" versus "street price" and configuration differences.

STEVE APIKI: The primary problem with this approach is that many systems we receive include goodies that aren't performance related. Say we get a 486 with a CD-ROM drive, a Super VGA monitor, and 16 MB of system RAM. What price do we use for the price/performance ratio? We can eliminate the CD-ROM drive right off. But additional memory translates to increased performance under Unix, and the full complement of 16 MB allows for memory interleaving, where the standard 1-MB version does not.

Does the Super VGA monitor mean you test applications using Super VGA drivers? If not, I could argue that your application benchmarks are unrealistic, because most users will run the machine in Super VGA mode. Price/performance would be nice to report, but coming up with a fair system for doing so is an intractable problem.

MITCHELL: BYTE does ask for exactly the same configuration for all machines in a head-to-head comparison. But if the configuration it requests is different from how the vendor typically sells the system, BYTE may bend the rules a bit. In this case, a price/performance ratio would be meaningless.

What makes BYTE different is that it doesn't publish price/performance numbers. Computer systems are much too complicated to reduce to a single ratio. Which index number would be used for the performance denominator? Which price and configuration would be used as the numerator?

Benchmark numbers make for good graphics, but the real story lies in the telling. Why did a machine do extremely well in the low-level video tests yet not excel in the application tests? Why did a machine with a SCSI caching hard drive controller not perform better than others with standard IDE hard drives? A good reviewer puts the numbers in perspective for the reader. ■

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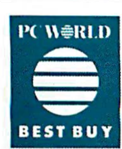


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DETAILS MAKE THE DIFFERENCE!

For instance, the battery system of your new notebook is the most advanced on the market. You can quick charge, or trickle charge, any time your system is plugged in. Or, you can use the optional charging stand if you wish.

Either way, you're sure to appreciate our light weight snap-in, snap-out battery packs. They're so light and easy to use, you can easily take an extra one with you on those really long trips. Plus, you can get even more life out of a single charge by using our programmable power management system. Hour upon hour of Notebook computing power!

CONNECTIVITY TOO!

Your new ZEOS notebook is a great connectivity tool! Using our optional built-in 2400 baud MNP® Class 5 modem, connectivity buffs will find themselves logging on at every turn.

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COVER STORY

FEATURE

THE 1991 BYTE Awards

The best products of the last year get the recognition they deserve

The 1991 BYTE Awards provide a snapshot of the most important events that occurred in the computer industry last year. Each of the 84 winners represents an achievement in its category that pushed the industry forward. Apple, for instance, answered the challenge posed by Microsoft's Windows 3.0, last year's top vote-getter, with its System 7.0, this year's number-one winner.

Meanwhile, Microsoft was busy producing products to support Windows. Three of those packages, Visual Basic, Word for Windows 2.0, and Excel 3.0, are among the award winners for 1991. Apple, in turn, built on System 7.0 with QuickTime 1.0.

Many products in the portable category won awards, including two notebooks from Toshiba, Psion's 8-ounce hand-held system, Citizen's PN48 portable printer, and Zenith's Mastersport 386SL. The most important winners in this area are not end-user products, however. Chips & Technologies and AMD introduced CPUs that should provide a shot in the arm for portable system developers.

Criteria

To be eligible for the 1991 BYTE Awards, a product must be new within the last year, and we must be reasonably sure that it will be commercially available by the time you read this. We chose products or technologies based on their impact; specifically, we looked for innovation, superior performance, and price breakthroughs.

BYTE editors and contributors nominate products or technologies for awards. Each editor or contributor then votes for his or her 10 most important products of 1991. Products with the highest number of votes receive Awards of Excellence, and mid-range vote-getters receive Awards of Distinction. Those products receiving the fewest votes are given Awards of Merit. No awards are given to nominees that do not receive any votes.

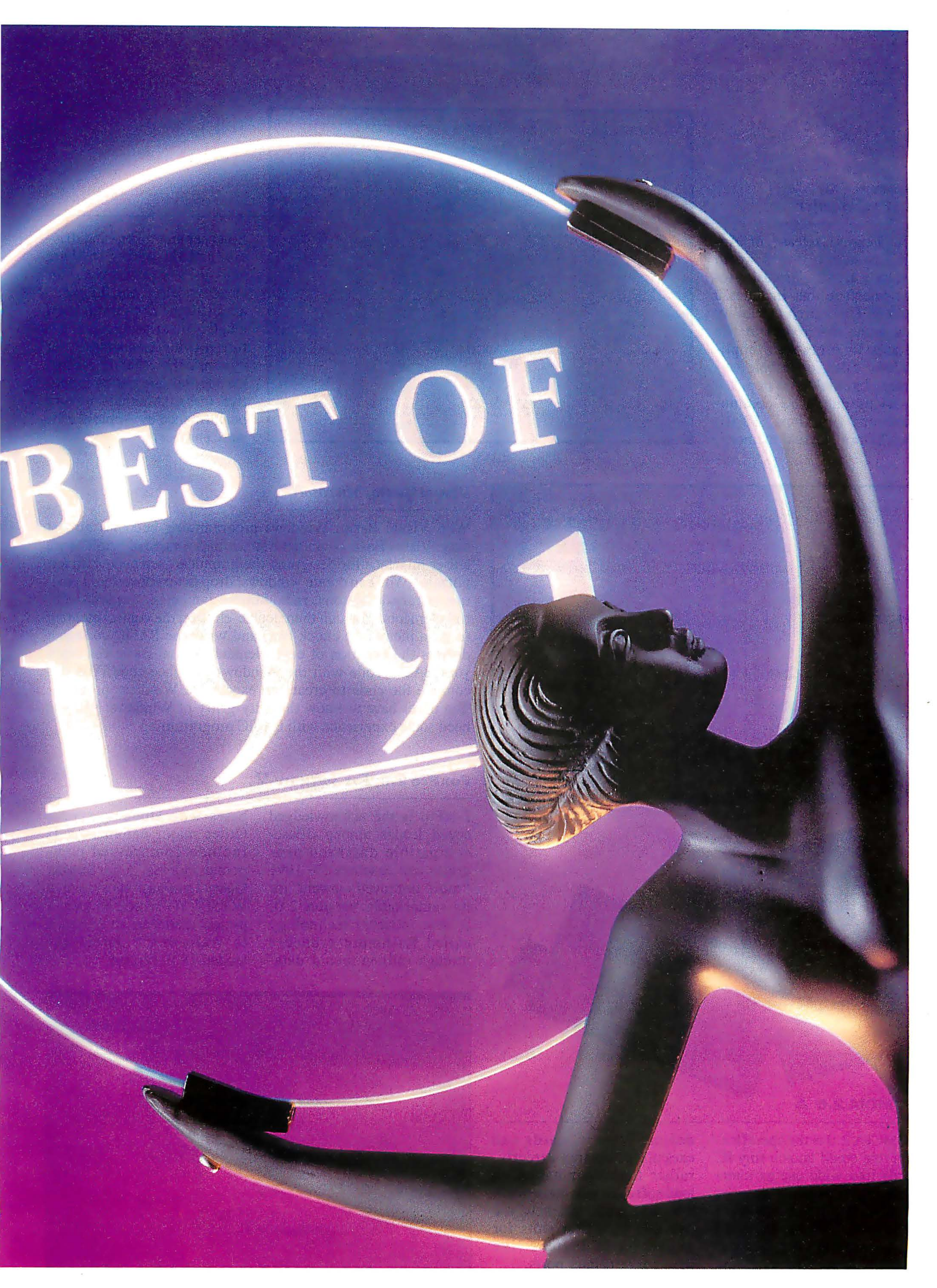
A World View

BYTE has many licensees around the world. These publishers reprint BYTE articles in their native languages. This year, we invited all BYTE licensees to participate in the 1991 Awards. We received lists of winners from three: *Nikkei BYTE* from Japan, *RAM* from Greece, and *Binary* from Spain.

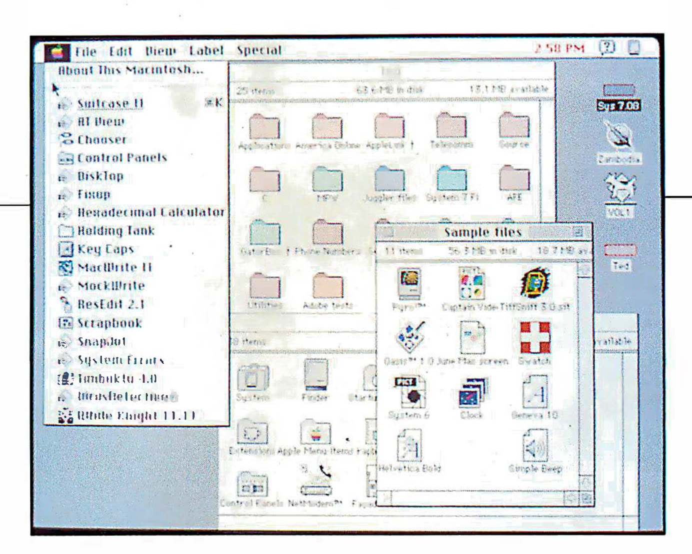
The editors of these magazines chose winners based on their importance to the regional computing community. Many of their selections match those of the BYTE staff's. This represents the increased globalization of the computer industry. Products today are more likely to be launched on a worldwide scale than in only one particular region. We hope you find the selections of *Nikkei BYTE*, *RAM*, and *Binary* as fascinating as we did.

—Michael Nadeau



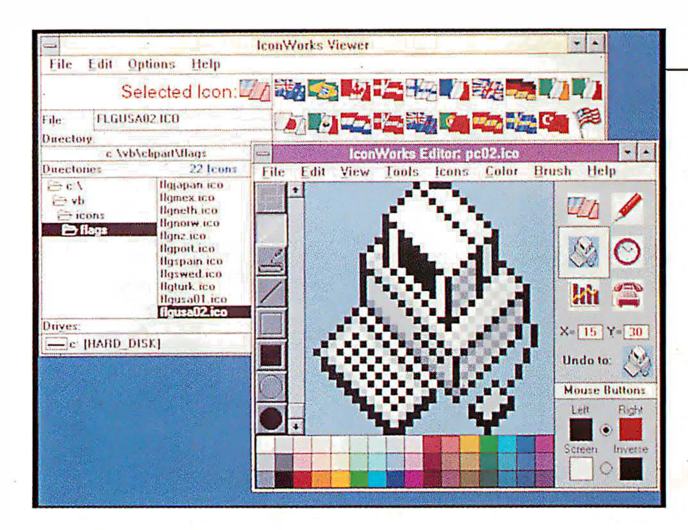


PHOTOGRAPHY: MEL LINDSTROM © 1992



System 7.0,
Apple Computer

The delayed release of Apple's System 7.0 was worth the wait: It offers an easier-to-use interface that includes a built-in file-search capability and icons that represent file aliases to often-used applications, files, or remote volumes. Internally, System 7.0 provides enhanced communications functions, 32-Bit QuickDraw, virtual memory, Ethernet and token-ring drivers, and the ability to share hard disks or folders with other networked users. Its Inter-application Communication and Open Scripting Architecture provide mechanisms for dynamically sharing information and automating repetitive tasks. Another bravura performance by Apple's software engineers.

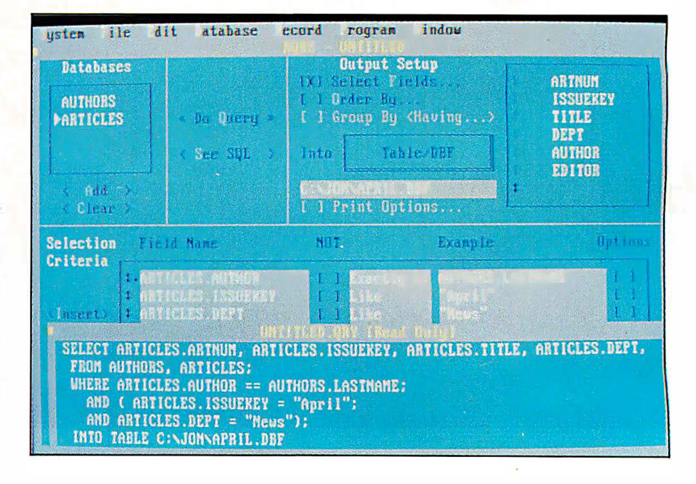


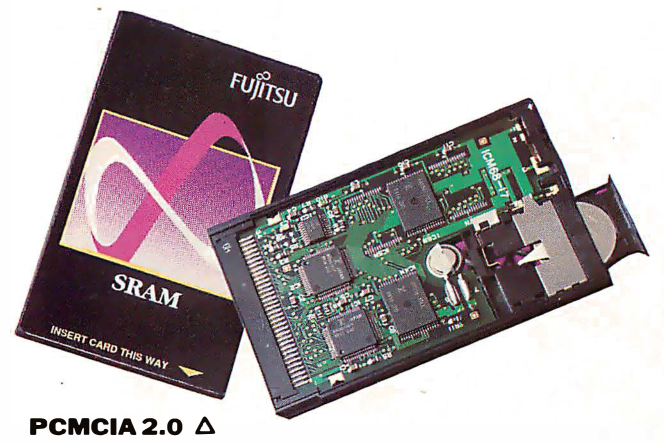
VisualBasic, ***Microsoft***

With Visual Basic, Windows programming becomes almost easy. Visual Basic combines a structured version of BASIC with a user interface for designing the graphical elements of an application. You can create windows; drop in text boxes; and position command buttons, radio buttons, and other graphics-control elements. You can then double-click on the control element (e.g., a menu or a check box) and write the BASIC code that defines the function of each element. Visual Basic combines your BASIC code with the Windows interface code. You can compile the code to create an executable Windows program. You never have to know the nitty-gritty of Windows; you just need some experience with BASIC programming.

FoxPro 2.0, ***Fox Software*** ▽

FoxPro is the acknowledged speed leader among dBase-compatible database programs and deserves the 1991 "most improved" award for its remarkable version 2.0. A new retrieval technology called Rushmore crunches through million-record databases with stunning speed. Other major enhancements include compressed compound indexes, a Structured Query Language subsystem, a WYSIWYG screen builder, a project manager, an interface to Watcom C, and an extended-DOS version.

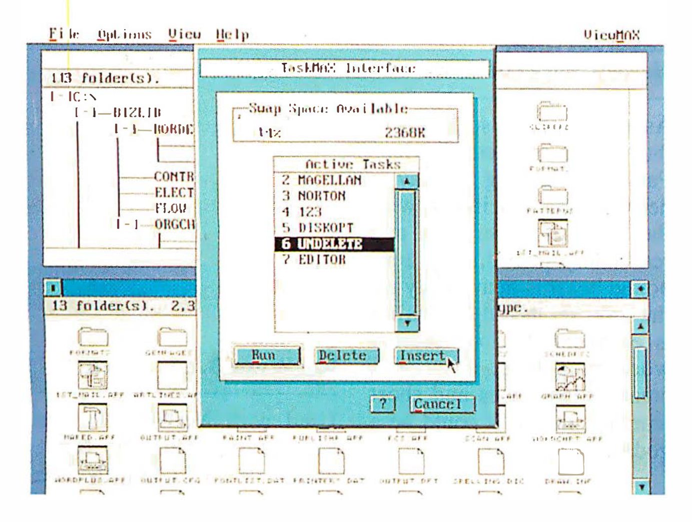




PCMCIA 2.0 △

PCMCIA 2.0 is the specification that could launch tiny IC cards into wide use as interchangeable storage devices for personal computers, palmtops, and hundreds of other noncomputer applications. The specification now defines how IC cards can execute programs directly, rather than your having to load software into main memory, and spells out how you can use PCMCIA slots for general I/O devices like modems or printer ports.

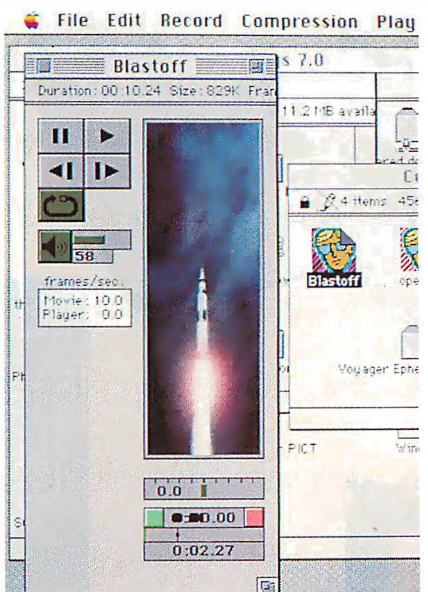




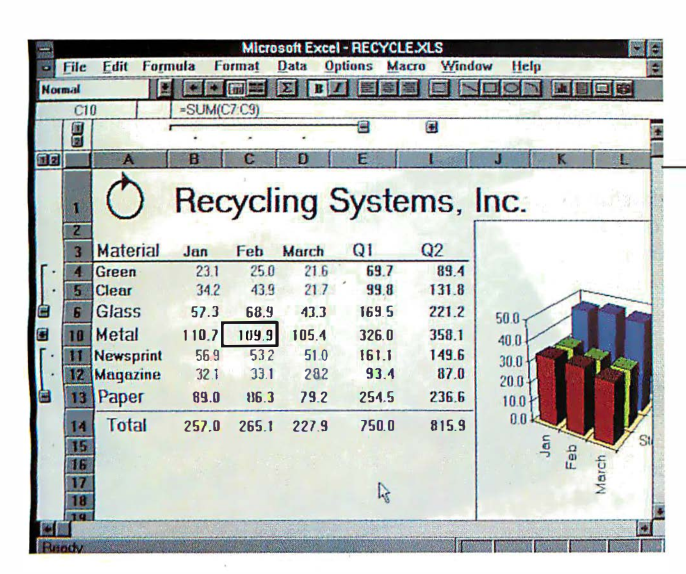
DR DOS 6.0, *Digital Research* △

It has taken a while, but Digital Research's DR DOS 6.0 seriously threatens to dethrone MS-DOS as king of the text-based operating systems. It features a better memory manager, a task switcher, and proven utilities for disk caching and file compression. Free lifetime support is another plus. DR DOS also comes with several networking tools, which suggests that new owner Novell might have even more interesting things in mind for this DOS challenger.

QuickTime 1.0, *Apple Computer*

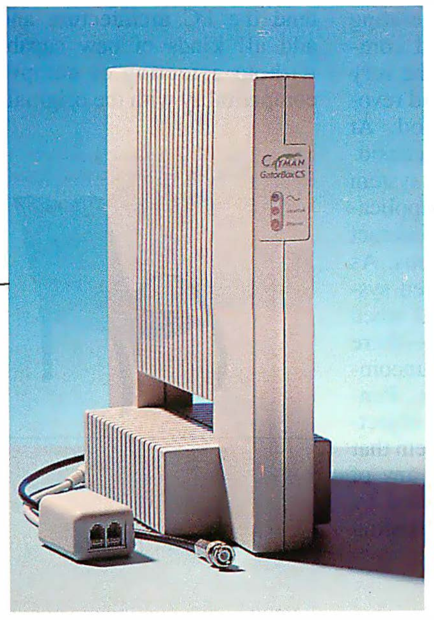


Apple's system software has always been outstanding, and now QuickTime 1.0 sets the stage for a marked advance in the use of multimedia technology in practical applications. With its new movie file format, QuickTime allows a standard way for applications to dynamically exchange data from one computing platform to another.



Excel 3.0, *Microsoft*

You really can improve an application years after it first arrives. Microsoft's Excel 3.0 represents a quantum leap over its predecessor, adding new icons, an auto-sum feature, best-fit column sizing, and a new outlining capability that lets you shrink your view of the spreadsheet. Most important, Excel 3.0 embraces direct manipulation, making it by far the most graphical spreadsheet available.



GatorBox CS, *Cayman Systems* ▷

Cayman Systems' GatorBox CS is simply the easiest way to tie together networks of Mac and Unix systems. For network administrators grappling with the thorny issues of interoperability, the GatorBox is a refreshingly elegant solution in a realm that usually requires working with partial solutions from a number of vendors that never quite dovetail. The GatorBox CS is a plug-and-play LocalTalk/Ethernet gateway that supports AppleTalk Phase 1 and 2, TCP/IP, and DECnet Level 1 protocols. Optional GatorShare software takes the link one step further by offering Network File System hosts (disguised as AppleShare volumes) to Macs on the connected LAN.

BYTE AWARDS

EXCELLENCE

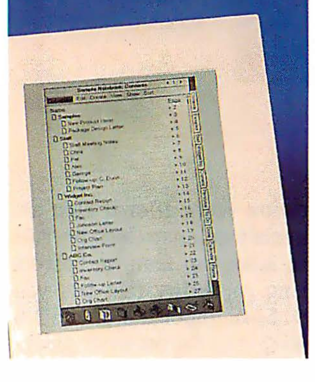
▽ LaserJet IIISi, *Hewlett-Packard*

As it has in other segments of the printer market, Hewlett-Packard is leading the way in network laser printers with the LaserJet IIISi. Fast and reasonably priced, this 106-pound beast is heavy duty all the way, yet its output quality is excellent. If your current workgroup laser printer is creating long lines and short tempers, the IIISi could be a godsend.



NetWare 3.11, *Novell* ◁

Used with NetWare for the Macintosh, NetWare NFS, and NetWare FTAM, the 386 version of NetWare now supports Mac, Unix, and PC client types (e.g., DOS and OS/2). NetWare 3.11's "name spaces" feature maintains machine-specific name information for each client type, preserving data and resource-fork information on the Mac and extended attributes on OS/2 clients. NetWare 3.11 is an expensive—but fast and reliable—LAN operating system for users who need to integrate multiple client types.

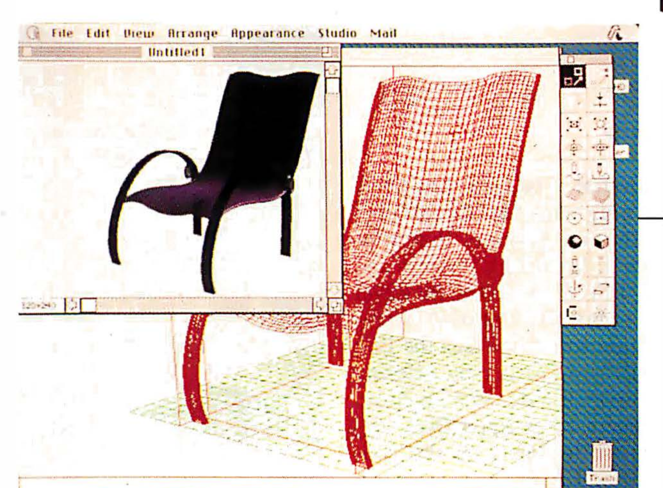


PenPoint, *Go Corp.* △

PenPoint is the first operating system for pen-based computers designed from the very beginning for a new and revolutionary input method. At every stage, Go Corp. considered how the operating system and the machines and applications using it would interact with users and their pens. As a result, PenPoint-based systems feel truly natural when operated with a pen—there are no awkward or uncomfortable compromises. PenPoint is also a truly object-oriented operating system that has not had to accept any of the limitations imposed by having to work with existing software.

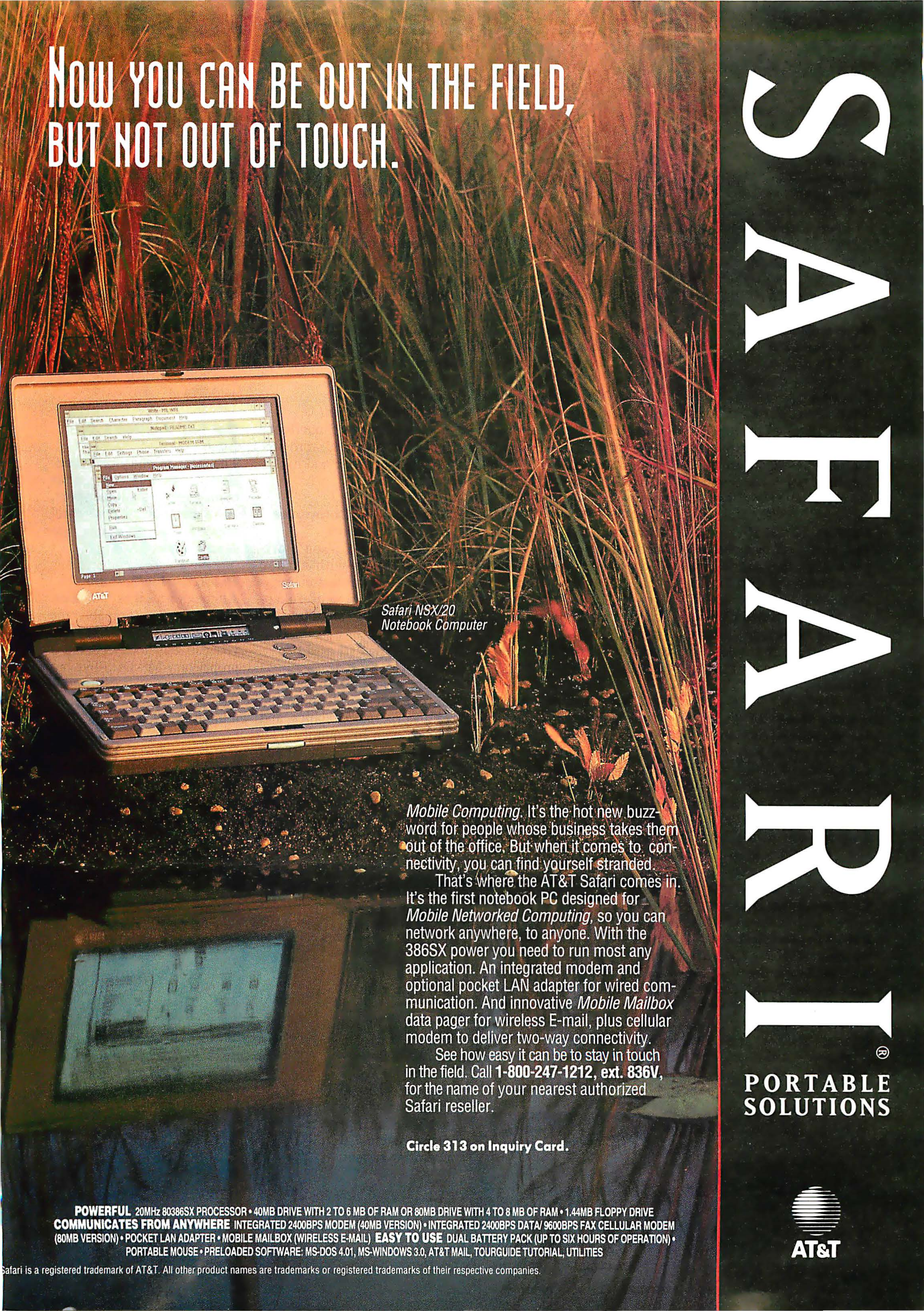
PC/Chip, *Chips & Technologies* ▷

The PC/Chip is the first true single-chip PC. It finally allows manufacturers of systems to build a computer using only one chip plus some memory. That alone would be an achievement, but Chips & Technologies has added to this with its architectural innovation of SuperState—a way to extend the PC architecture and add all kinds of new capabilities without affecting or compromising its compatibility with the original.



Sketch, *Alias Research*

The Mac-based Sketch is one of the fastest and coolest three-dimensional CAD/solids modelers we have ever seen. With such features as its Curve-o-Matic tools, you can produce complex 3-D wireframe models using 2-D techniques. It is coming soon in a Windows version, too.


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BYTE AWARDS

DISTINCTION

Am386,
Advanced Micro Devices
The Am386 does not break new ground—it is a faster clone of the Intel 386DX—but it certainly has lit a fire under Intel. It is probably the main reason we now have 486SX-16, -20, and -25 machines.

Grolier Electronic Encyclopedia (1991 edition),
Grolier Electronic Publishing
With the addition of sound and more pictures, this CD-ROM is an inexpensive and useful introduction to multimedia. It is a great excuse for buying a CD-ROM drive.

NCR 3125, *NCR*
The first (but not the last) pen-based computer designed to run both Go Corp.'s PenPoint and Microsoft's Windows for Pen-Based Computing. The NCR tablet features a clear screen, a wireless stylus, and good power management.

Norton Desktop for Windows, *Symantec*
An essential add-on to Windows, Norton Desktop for Windows replaces the clumsy Program Manager and File Manager with an elegant drag-and-drop desktop. It also tosses in a grab bag of goodies ranging from Norton Utilities and Backup to a file shredder and screen saver.

PN48 Professional System, *Citizen America*
Small and cute, the PN48 represents a big improvement in output quality for portable printers. If appearance is everything to you, this is the printer you want as a travel companion. ▽

Quest for Windows,
Gupta Technologies
Getting information from a relational database usually involves constructing queries in Structured Query Language—a language that does not enjoy a sterling reputation for user-friendliness. Quest, a Windows 3.0–based graphical data-access tool, changes that. It allows you to create SQL queries simply by pointing and clicking with your mouse. You can use the data-access tool to access everything from the tool's built-in relational database engine to your corporate DB2 database. Client-server computing has never been so easy.

Stacker 2.0,
Stac Electronics
Couple a compression utility that's 30 percent faster than version 1.0 with a 16-bit AT add-in card, and you can double the size of your hard disk with no performance degradation.

T2200SX, *Toshiba*
To borrow an automaker's advertising slogan, the Toshiba T2200SX "just feels right." The company has made the notebook as small as is practical, while providing a superb keyboard, an excellent screen, and a durable carbon-reinforced case.

The Network Archivist 2.0, *Palindrome*
Palindrome's latest release adds workstation backup capability, Mac file support, and tape diagnostics to an already outstanding backup product. TNA 2.0 retains the support for different storage levels and automatic file migration that distinguished earlier versions.

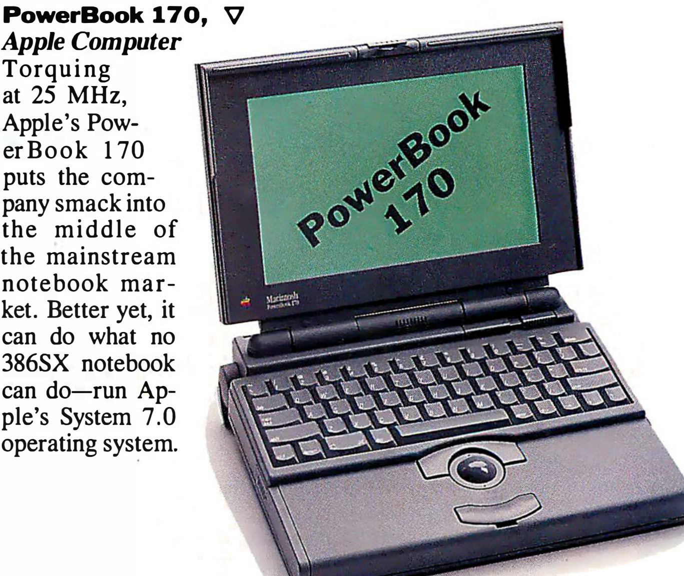
Word for Windows 2.0,
Microsoft
The folks who designed Windows prove again that they are the ones who best understand the concept of Windows applications. While Word for Windows 2.0 is filled with every feature you'd ever imagine, its biggest claim to fame is an elegant interface that lets you get useful work done with a minimum of effort.

Ami Pro 2.0,
Lotus Development
Lotus's unique SmartIcons make this powerful word processor easy to use and highly customizable.

The Far Side Computer Calendar, *Amaze*
Couple Gary Larson's offbeat cartoons with a good personal information manager, and you get a useful application that's fun, too.

LaserWriter IIf and IIg,
Apple Computer
These two 68030-powered laser printers are optimized to incorporate graphics and photos with top-quality text. Both networkable, the IIf and IIg feature PostScript Level 2, an 8-page-per-minute Canon laser engine, and an 800-dot-per-inch equivalent output via Apple's Photograde technology.

PowerBook 170, ▽
Apple Computer
Torquing at 25 MHz, Apple's PowerBook 170 puts the company smack into the middle of the mainstream notebook market. Better yet, it can do what no 386SX notebook can do—run Apple's System 7.0 operating system.



Mac Quadra 900,
Apple Computer
What comes after "wicked fast?" A lot of memory and board expansion, as well as the killer 68040 processor.

Moby Brick,
Ergo Computing
Classy-looking and powerful, the 486-powered Moby Brick is a great high-end solution for travelers who need all the capabilities of a desktop while on the road.

Net Satisfaxtion 1.0,
Intel
The best of the non-standalone fax servers. You get fax management, a scanner port, and a communications coprocessor for the amazingly low price of under $500.

Psion Series 3, *Psion*
Although it weighs 8 ounces, the Series 3 is arguably the most useful pocket computer you can buy today. Using a proprietary MS-DOS-like operating system, it can multitask up to 28 operations simultaneously.

Sparcstation IPX,
Sun Microsystems
A machine that's everything a workstation (or any computer, for that matter) should be—small, fast, loaded, and reasonably priced.



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DISTINCTION

CDR-1000, ***Tandy***
Another example of Tandy's aggressive push to make multimedia common in the computer community. At $399, it's hundreds of dollars less expensive than its competitors and has the high-speed data transfer needed to handle Microsoft's multimedia extensions to Windows.

IBM 3.5" Rewritable Optical Drive, ***IBM***
The storage wave of the future. IBM has managed to combine, in one device, support for both rewritable (magneto-optical) and optical read-only 3½-inch discs, opening up new possibilities for software and data distribution, as well as local and network data storage.

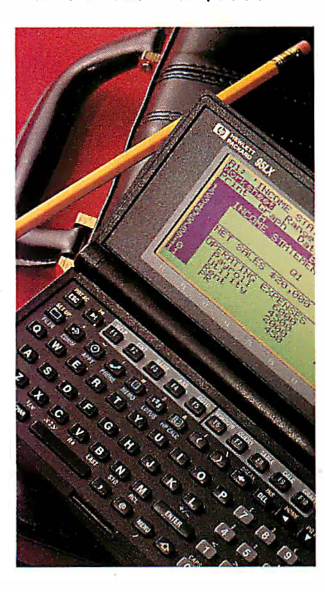
Borland C++ 3.0, ***Borland International***
The combination of C++ 2.0, the Integrated Development Environment, the Object Windows Library (the C++ application framework for Windows), and Turbo Vision (the C++ application framework for character-mode DOS GUIs) makes for a stupendous offering.

CorelDraw 2.0, CD-ROM edition, ***Corel Systems***
Despite fierce competition in the Windows illustration package market, CorelDraw 2.0 consistently comes out ahead: It manages to combine professional-level power with usability by mere mortals. The CD-ROM edition has over 4000 clip-art images and symbols, along with all the drawing, type manipulation, special effects, and tracing features of the standard edition.

AddressWriter, ***CoStar***
The logical extension to label printers. It makes the pesky job of printing envelopes almost a pleasure.

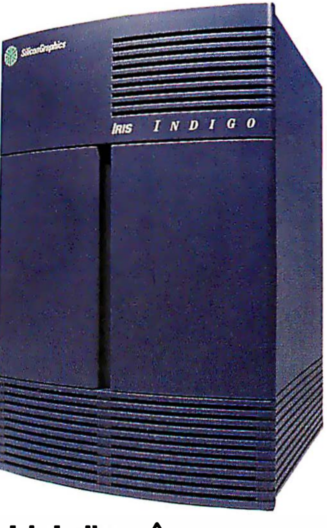
Full Page Pivot, ***Radius***
Radius brings its unique portrait and landscape monitor technology—the only way to do serious word processing and desktop publishing work—from the Mac to the PC platform.

GT486/40, ***Falco***
If you push a 486 to 40 MHz, couple it with 32 MB of RAM, a 426-MB hard drive, a 1024- by 768-pixel graphics system, and put it all in a box that's the size of a large book, you have an ultimate graphics system that will easily compete with high-ticket Unix workstations—for $6000.



HP 95LX, △ ***Hewlett-Packard***
Yes, the keyboard is not good and the screen is small, but this is an incredible pocket-size computer. It is also the only system of any size with built-in Lotus 1-2-3 and infrared connectivity.

HP Apollo 9000/Series 700, ***Hewlett-Packard*** ▷
Defying the trend toward building Unix workstations and servers around standard processor platforms, Hewlett-Packard came out with a new generation of its homegrown Precision Architecture RISC chips and blew the lid off the competition. The HP Series 700 family of systems offers the best price/performance on the market, and it puts HP squarely back in the workstation race.



Iris Indigo, △ ***Silicon Graphics***
Petite yet powerful, the Iris Indigo brings three-dimensional graphics computing to an affordable level. Silicon Graphics has sacrificed little in the process. The Iris Indigo has a 33-MHz Mips R3000A CPU and a proprietary backplane and bus that allow a 133-MBps transfer rate.

LapLink Pro 4.0, ***Traveling Software***
Traveling Software's venerable file transfer utility steps into the 1990s with a new interface and even faster speed, keeping the package comfortably ahead of its competitors.

MS-DOS 5.0, ***Microsoft***
It is not just the extra 40 KB of workspace that makes MS-DOS 5.0 a significant product; it's also the integration of the Smartdrive disk cache, the ability to handle large disk volumes fast, and the Undelete feature. Unlike Windows, this package was largely bug free.

NuVista+, ***Truevision***
This NuBus video board for the Mac does everything—composite/RGB/S-video in, composite/RGB/S-video out, multiple programmable resolutions (both interlaced and noninterlaced), and the ability to be programmed for digital effects. It also includes a built-in chromakey.

286|DOS-Extender, ***Phar Lap***
The Phar Lap 286|DOS-Extender now supports Borland C++ and Microsoft FORTRAN as well as Microsoft C. That'll make it a cinch for programmers writing hordes of DOS applications to have those applications run in protected mode and, thanks to the DOS Protected Mode Interface, to multitask under Windows enhanced mode.

PowerLAN 2.10, ***Performance Technology***
The fastest peer-to-peer LAN available today.

Rapport, ***Clarity***
A Unix document processor, spreadsheet, E-mail utility, drawing program, and audio editor. Rapport does a number of things and links them together nicely.

Nanao T560i, ***Nanao USA***
Nanao's 17-inch T560i sets a new standard for desktop displays. Once you've seen Windows at 1280 by 1024 pixels (with 70-Hz refresh), you'll never go back.



Imagine getting twice the Bernoulli for two-thirds the price.

The new Bernoulli 90MB.



Welcome to the next generation of removable storage, the new Bernoulli® 90 from Iomega®.

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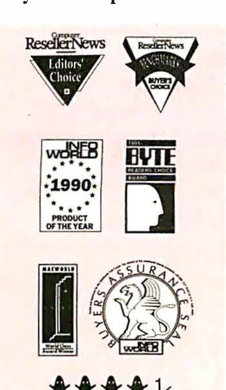
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If you need more storage, you'll welcome the Bernoulli 90, since it's now comparable in price to a hard disk upgrade. So why not buy a hard disk? Consider what you *don't* get with a hard disk.

You don't get infinite storage in 90-megabyte increments—hard disks fill up. You don't get 180MB of easy backup. You don't get the physical security of removable data disks, or head-crash-resistant technology. You don't get compatibility with all major operating systems, and workstations. And you don't get Central Point's Backup software.

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Circle 81 on Inquiry Card (RESELLERS: 82).

BYTE AWARDS

MERIT

Lotus 1-2-3 for Windows, *Lotus Development*
This is a key product that Windows users have been waiting for.

4th Dimension 2.1, *Acius*
The most powerful relational database development system available for any microcomputer.

386Max 6.0, *Qualitas*
Neither MS-DOS 5.0 nor Windows 3.0 can yet match the memory management capabilities of this utility.

ATI 8514-Ultra, *ATI*
An inexpensive, fast, high-resolution graphics adapter that helps deliver the promise of Windows 3.0.

Adobe Illustrator 3.0, *Adobe Systems*
The premier professional graphics package for the Mac gets even better. Now there is a Next version, too.

Altair, *Motorola*
Altair uses microwave radio in the gigahertz region, giving it bandwidth high enough to support Ethernet at full (10-Mbps) speed.

Chaos: The Software, *Autodesk*
A cutting-edge application that lets you explore the new science of chaos.

ClarisWorks, *Claris*
Integrated software for the rest of us—powerful, inexpensive, and easy to use.

Distributed Computing Environment, *Open Software Foundation*
DCE is a solution to the seemingly intractable problem of getting all your different types of computers to work together.

Dr. Solomon's Virus Toolkit, *Ontrack Computer Systems*
Good medicine for when your personal computer catches the flu.

EktaPlus 7016 Printer, *Eastman Kodak*
A hybrid printer and copier that demonstrates innovative engineering by Kodak.

Harvard Graphics for Windows, *Software Publishing*
This package offers the best compromise between ease of use and presentation power.

MacDraw Pro, *Claris*
A Mac-based drawing package upgraded to handle 32-bit color.

Mac Topas and Topas VGA, *AT&T Graphics Software Lab*
Two affordable, feature-packed three-dimensional rendering and animation programs for the Mac and the PC.

Mastersport 386SL, *Zenith Data Systems*
The first 386SL notebook, and still one of the best SL designs.

Apple Mode32, *Connectix*
Apple Mode32 patches Mac II, IIx, and SE/30 ROMs to make them 32-bit clean. Apple now distributes it for free.

Momenta Pen System, *Momenta*
The first notebook PC to provide practical pen-assisted applications.

Nisus 3.06, *Paragon Concepts*
This slick Mac word processor continues to get better and better.

ObjectVision, *Borland International*
ObjectVision allows visual programming of forms and includes a Paradox-compatible database manager.

On-Target, *Symantec*
The first project management package that lets you get serious planning work done without needing a master's degree in the subject.

Outbound Notebook System Model 2000, *Outbound Systems*
The first Mac-compatible notebook PC gets better.

PacificPage XL, *Pacific Data*
For $999, this hardware and software package turns your Hewlett-Packard LaserJet into a blisteringly fast PostScript printer.

PageMaker 4.0, *Aldus*
Aldus got rid of many of PageMaker's limitations in this new release. It can now handle larger documents and multiple documents.

QuickC for Windows 1.0, *Microsoft*
The decision to include a simple applications generator will probably push this tool to the number-one spot among Windows developers in a hurry.

Realizer, *Within Technologies*
BASIC for Windows programmers, amateur and professional alike.

Safari NSX/20, *AT&T Safari Systems*
A snazzy notebook PC with well-integrated communications capabilities.

HP ScanJet IIc, *Hewlett-Packard*
Hewlett-Packard brings full-page and full-color 24-bit scanning to both the PC and the Mac at a low price.

Shortcut, *Aladdin Systems*
Performs file searches on a Mac using multiple criteria, even from archived files.

T4400, *Toshiba*
Only slightly taller than the T2200SX, the T4400 is a 486SX system with long battery life.

The World of C++, *Borland International*
Borland's irrepressible David Intersimone takes much of the pain out of learning essential object-oriented programming concepts.

Thunder/24, *SuperMac Technology*
This is a 68040-compatible accelerated display board for the Mac.

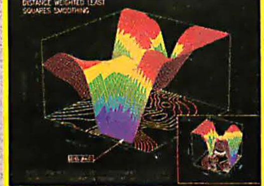
Timbuktu 4.0 and Timbuktu/Remote 3.0, *Farallon Computing*
These packages allow you to view and control remote Mac screens.

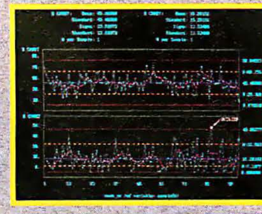
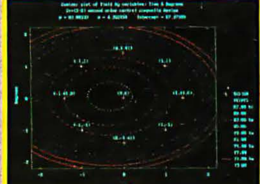
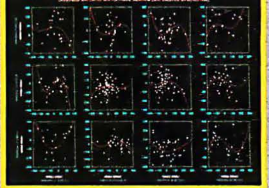
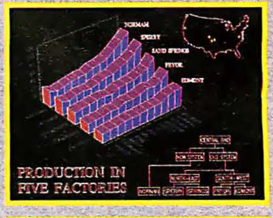
Ashlar Vellum for Silicon Graphics, *Ashlar*
An excellent CAD program that shines on a serious workstation like the Silicon Graphics Iris Indigo.

WinPrinter 400, *LaserMaster*
The first laser printer designed to work specifically with Windows. It is host-based, using your PC's CPU for processing power.

Z-Mail 2.0, *Siren Software*
A Unix GUI-based mail program that sets new standards in simplicity, programmability, features, and performance.

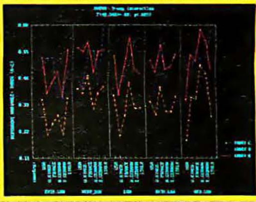
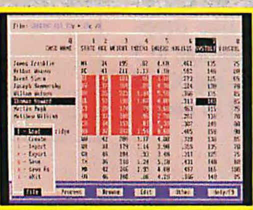
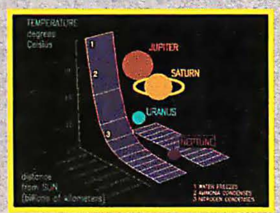
CSS:STATISTICA

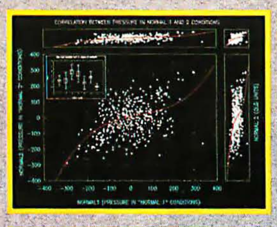
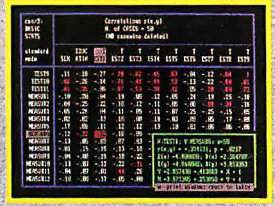


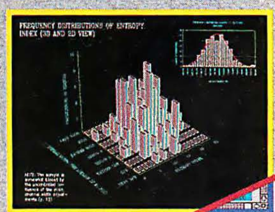
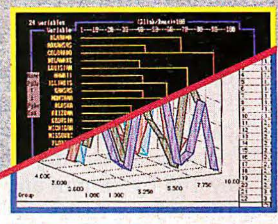
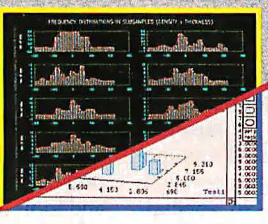
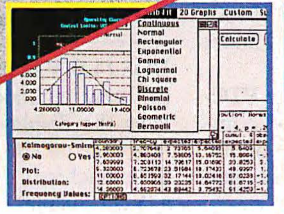
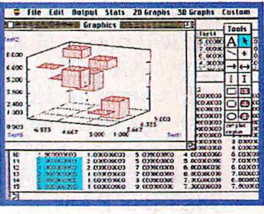






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Megafile Manager™ Comprehensive analytic data base management system ■ Unlimited size of files (up to 32,000 fields or 8 MB per record) ■ Megafile Manager is included in CSS/3 and CSS:STATISTICA (separately: **$295).**

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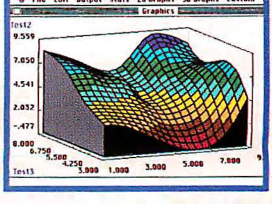
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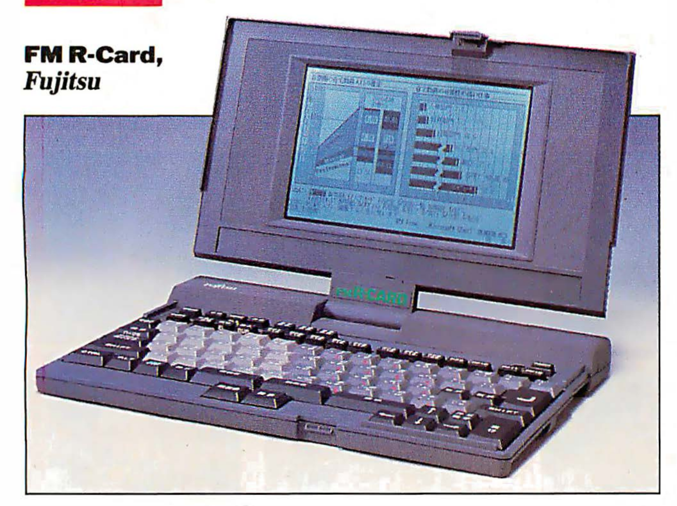
Overseas Offices: StatSoft of Europe (Hamburg, FRG), ph: 040/4200347, fax: 040/4911310; **StatSoft UK** (London, UK), ph: 0462/482822, fax: 0462/482855; **StatSoft Pacific** (Melbourne, Australia), ph: 613-866-1766, fax: 613-866-3318; **StatSoft Canada-CCO** (Ontario), ph: 416-849-0737, fax: 416-849-0918. Available from: CORPORATE SOFTWARE and other Authorized Representatives Worldwide: Holland: Lemax BV 02065-98701; France: VERSION US (1) 40590913; Sweden: AkademiData 018-240035; Spain: ADDLINK, SRL; ph: 34-3-459-0722.

BYTE AWARDS

NIKKEI BYTE

EXCELLENCE

FM R-Card, *Fujitsu*



The Fujitsu FM R-Card fits in a briefcase and offers the features of a desktop machine. It weighs only 2.2 pounds, measures 11.6 by 8.3 by 1.04 inches, and has a full-size keyboard. It runs for 8 hours on two AA-size alkaline batteries—the result of major new technologies, like dropping the operating voltage to 3 volts and halting the supply of power to circuits not in use. It costs 238,000 yen.

DD-DR1, *Sony* ▽

The Sony DD-DR1 is an electronic book—a CD-ROM drive handling 8-cm discs. It is linked through an RS-232 interface for read processing. This makes it possible to insert CD-ROM data into PC files. The system also has a 256- by 200-mm dot-pitch monochrome graphics display and an ADPCM (adaptive differential pulse-coded modulation) audio playback function (a subset of the CD-ROM XA standard).



DISTINCTION

PTC-300, *Sony* ▷



The Sony PTC-300 is the third model in Sony's palmtop line of pen computers. While the previous models were designed to fit in an attaché case, the PTC-300 fits in your pocket, measuring only 105 by 165 by 28 mm and weighing 355 grams. It costs 65,000 yen, or about US$400, and will run for about 9 hours on two AA cells.

In spite of its size, the PTC-300 is a full-fledged computer with an 8-MHz 68000 CPU, 2.5 MB of ROM, and 288 KB of RAM.

DOS J4.0/V (Japanese version), *IBM Japan*

DOS J4.0/V is an epoch-making new technology that allows the display of Japanese language on IBM AT-compatible machines equipped with a VGA display. No specialized hardware, such as a Japanese language character generator, is required. This means that if you use DOS J4.0/V, you can purchase inexpensive IBM compatibles from overseas. It spells an acceleration of the reduction of PC prices in Japan.

BYTE AWARDS

RAM

EXCELLENCE

MS-DOS 5.0, *Microsoft*

The new full-featured edition of the world's most popular operating system is a major upgrade that conforms well to the elevated needs of today's applications software. Several application programs can use extra breathing space; MS-DOS 5.0 provides that. With MS-DOS 5.0, the average user has a flexible and powerful set of commands and tools available right at the DOS prompt.

Excel 3.0, *Microsoft*; **Lotus 1-2-3 for Windows,** *Lotus Development*

The new generation of graphical spreadsheets for Windows offers a whole new class of capabilities combined with a much higher level of ease of use than previous generations. Even novice users can now comprehend the basics of spreadsheets and start using them in a few hours. By using Windows' Dynamic Data Exchange, you can integrate Lotus 1-2-3 for Windows and Excel with other applications in a modern and powerful desktop environment that improves productivity considerably.

System 7.0, *Apple Computer*

The long-awaited System 7.0 delivers countless new features to the Mac. It is very stable and has few compatibility problems. It requires as little as 2 MB of RAM and runs without problems even on a Mac Plus.

BYTE AWARDS

RAM

HP LaserJet IIIp,
Hewlett-Packard

By providing its classic 4-page-per-minute "p" box with PCL-5 and resolution enhancement capabilities, Hewlett-Packard has once again redefined the basic, low-cost laser printer.

HP LaserJet IIISi,
Hewlett-Packard

The new top-of-the line Hewlett-Packard laser printer offers a 16-page-per-minute printing engine, PCL-5 with resolution enhancement, and elevated processing power, giving network users a much-needed tool.

PowerBook 170,
Apple Computer

The most powerful of Apple's new notebook trio, the PowerBook 170 packs all the characteristics you can imagine in a very compact and light case. Its price is high, but it offers advanced technology, a 25-MHz 68030 processor, and the best black-and-white screen you can buy for a portable computer: Apple's backlit AMLCD.

Quadra 700,
Apple Computer

Even though Quadra is not Apple's flagship, it offers the best price/performance ratio for those who really need power. Almost two times faster than the IIfx, it is the ideal machine for demanding applications such as CAD and desktop publishing.

Visual Basic, *Microsoft*

Microsoft's Visual Basic has brought Windows programming to thousands of BASIC users. It offers programmers all the necessary tools for designing a Windows application. With Visual Basic, it is easy to create the user interface, one of the most complex and time-consuming tasks of the GUI environment.

Turbo Pascal for Windows,
Borland International

Borland has done it once again. In fact, it has kept its promise with a highly extended version that remains compatible with the last Turbo 6.0. Turbo Pascal for Windows offers a completely integrated environment. The programmer has a powerful language with object extensions that ease the job and invoke creativity.

DeFacto, *Computer Logic*

DeFacto from Computer Logic is a business software package targeted to medium- and big-scale companies. DeFacto deals with the whole process of a business: It takes incoming orders, controls customer support, keeps information on cash flow, has a fully featured inventory control, and produces the invoices in an easily adaptable format.

Photoshop 2.0, *Adobe*

The original version of Adobe's Photoshop received worldwide acclaim and also won a 1990 BYTE Award of Excellence. Now, Adobe outperforms itself with the second release of Photoshop, which gives artists incredible power. Direct CMYK (cyan, magenta, yellow, black) editing is supported, and you can import Illustrator 3.0 files. Photoshop 2.0 can easily match the power of dedicated prepress systems like Hell or Scitex.

3D Studio, *Autodesk*

The name *Autodesk* is usually associated with hallmark products in the CAD category, with AutoCAD being the most famous example. The same seems to be happening in the area of animation. 3D Studio seems to be the first mainstream PC-based application that allows the production of professional-looking applications.

DISTINCTION

Sharp TFT,
Sharp Electronics
Sharp has amazed everyone with this TFT color LCD screen for the PC-8500 portable computer. The price is high, but so is the temptation.

CorelDraw 2.0,
Corel Systems
CorelDraw 2.0 offers outstanding capabilities to the graphic artist and the novice alike. Besides its excellent handling of type, it offers a large number of clip-art images and symbols.

XGA Video Adapter, *IBM*
IBM's new video adapter offers improved resolution, a wider choice of colors, and some local processing. IBM has also popularized the standard by permitting its free use by manufacturers.

AutoCAD release 11,
Autodesk
The latest release of the best-known design program has an environment that facilitates the development of the already-numerous add-on programs that are in the market.

SCO Unix MPX,
The Santa Cruz Operation
The MPX extension of Unix from SCO takes full advantage of the new double-processor structure of today's top machines. It can allocate the jobs to be executed to either processors, thus better utilizing the system.

OLE Specification,
Microsoft
The Object Linking and Embedding specification, although not fully implemented at the moment, is a great step forward. No application is an island anymore, and this specification allows applications to interact seamlessly.

QuickTime 1.0,
Apple Computer
Apple is setting new standards for multimedia with this excellent piece of software. On a Mac, QuickTime 1.0 ensures that all movies are played at the same speed.

Canvas 3.0, *Deneba*
Deneba's popular drawing program is now even more powerful. Fully supporting System 7.0, with a huge library of add-ins, Canvas 3.0 is an excellent tool for everyone—novice or professional.

Tekton, *LH Software*
This design program provides three-dimensional tools that help an architect easily design and edit natural objects, such as a wall, roof, or staircase.

WordPerfect 5.1, Greek edition *WordPerfect*
WordPerfect 5.1 is the first major player in the word processing market to appear with full support of the Greek language.

PC Tools 6.0,
Central Point Software;
Norton Utilities 5.0,
Symantec
PC Tools and the Norton Utilities are a pair of packages that can save valuable data that has been struck by computer gremlins. Both programs are a must for every computer user.

ScanMaster 1850S,
Microtek
Microtek's 35mm slide scanner is a real breakthrough in price and performance. With a street price close to that of a color scanner, the ScanMaster can be the slide scanner for everyone.

SuperBase 4,
Precision Software
SuperBase 4 offers a powerful and integrated platform for developing applications under Windows 3.0.

Am386,
Advanced Micro Devices
Besides being the fastest 386 processor, the Am386 has also established a price/performance ratio that is better than ever before.

HMA DOS 5.0 XMS BUFFERS UMB 386MAX 486SX DRIVERS 386SX NETWORKS TSRs BLUEMAX C&T 286

DOS 5.

DOS 5 with MAX 6.

BLUEMAX 6 NEW 386MAX 6

There's no doubt about it. DOS 5 is the sleekest, most convenient, most powerful DOS upgrade in history.

And it's a great place to start if you really want to get the ultimate in PC performance–without even lifting a finger.

New MAX 6–the driving force in automatic memory management.

Top performance requires as much conventional memory as possible. So applications can run faster. And so you can load Windows, TSRs, even a network, and have memory to spare.

Of course, DOS 5 helps with its smaller program size. And it does let you load programs high–if you want to do it by hand.

But for optimal memory management that's totally automatic, you need new MAX version 6–386MAX® for PC compatibles, and BlueMAX™ the only memory manager designed to recover up to 250% more high DOS memory on IBM PS/2s.

They're the dramatically advanced versions of the fastest growing brand of memory managers in the world. Now with better memory recovery, superior optimization, and amazing ease of use.

Intelligent, thoughtful, and totally reliable.

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Like new 386MAX ROMsearch™ that recovers massive holes of unused system BIOS memory. New 386MAX VGAswap™ that creates more contiguous memory on all VGA/EGA systems.

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And using MAX 6 is a cinch thanks to the new graphical interface, complete with pull-down menus, mouse support, and context-sensitive help. There's even a new improved version of ASQ,™ the intelligent system analyzer and tutorial, right on board.

The ultimate in power and luxury is more affordable than ever.

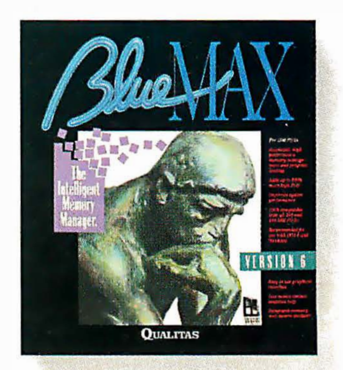
New 386MAX 6 for 286,* 386, and 486 PC compatibles is now just $99.95. And new BlueMAX 6 for 386 and 486 IBM PS/2s is only $124.95.

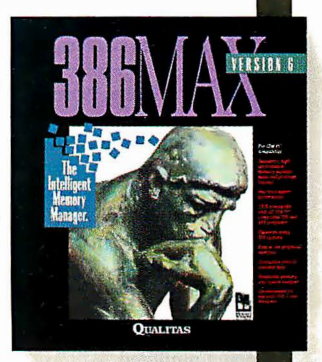
Frankly, whether you use DOS 5 or not, only MAX 6 will have you on your way to maximum PC performance with an absolute minimum of effort.

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Call to upgrade for just $29.95 plus $5 S&H.**





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HMA BUFFERS UMB 386MAX 486SX DRIVERS 386SX NETWORKS TSRs BLUEMAX C&T 286

BYTE AWARDS

RAM

Open, *Singular*
Open from Singular is a commercial program generator that uses the "open" concept. It consists of basic rules and entities for each business package, and a fully flexible, adaptable, and customizable environment for the user and programmer. Although it runs under DOS, the user interface is very well designed.

High Refresh Specification, *VESA*
The vertical refresh rate of 72 Hz proposed by the Video Electronics Standards Association deserves praise for its comfortable way of interfacing humans with computer monitors. Whatever combination of resolution and colors you use, there's no flickering on the sides of the screen.

MERIT

Touchbase Worldport Fax/Modem 2496, *USRobotics*

FrameMaker 3.0, *Frame Technologies*

PN48 Professional System, *Citizen America*

LaserWriter IIg, *Apple Computer*

Trackball, *Microsoft*

Radius Rocket Accelerator Card, *Radius*

Personal R:Base, *Microrim*

Now Utilities 3.0, *Now Software*

BYTE AWARDS

BINARY BYTE AWARDS

EXCELLENCE

Visual Basic, *Microsoft*

Norton Desktop for Windows, *Symantec*

MS-DOS 5.0, *Microsoft*

System 7.0, *Apple Computer*

IBM PS/2 Model P75, *IBM*

LSX-5000, *Olivetti*

DR DOS 6.0, *Digital Research*

Excel 3.0, *Microsoft*

Sony 128-MB rewritable optical disks, *Sony*

NetWare Lite, *Novell*

Desqview/X, *Quarterdeck*

Teac 2.88-MB floppy drives, *Teac America*

WordPerfect for Windows, *WordPerfect*

QuickTime 1.0, *Apple Computer*

DISTINCTION

NEC MultiSync 3FG, 4FG, *NEC*

NCR System 3125, *NCR*

Canon Ion, *Canon;* **Photoman,** *Logitech*

Phaser II PXI, *Tektronix*

Zortech C++ 3.0, *Symantec*

PC Tools 7.0, *Central Point Software*

PowerBook, *Apple Computer*

HP LaserJet IIISI, *Hewlett-Packard*

Idea I + D, *WinLogo*

FasMath, *Cyrix*

Dell 325NC, *Dell;* **NB-SL/25c,** *Epson*

PenPoint, *Go Corp.*

3D Studio, *Autodesk*

NetWare 3.11, *Novell*

PC/Chip F8680, *Chips & Technologies*

Am386DXL-40, *Advanced Micro Devices*

HP 95LX, *Hewlett-Packard*

HP DeskJet 500 Color, *Hewlett-Packard*

CorelDraw 2.0, CD-ROM edition, *Corel Systems*

MERIT

Mathematica for Windows, *Wolfram Research*

Ventura Publisher 4.0 for Windows, *Ventura Software*

Hercules Graphics Station Gold, *Hercules Computer Technology*

NetWare 2.2, *Novell*

Borland C++ 2.0, *Borland International*

IBM XGA Display Adapter/A, *IBM*

Mastersport 386SL, *Zenith Data Systems*

QuickC for Windows, *Microsoft*

Ultra 144, *Hayes*

Dell 450DE, *Dell*

Iris Indigo, *Silicon Graphics*

Quattro Pro 3.0, *Borland International*

Ami Pro 2.0, *Lotus Development*

Lotus 1-2-3 for Windows, *Lotus Development*

SCSI-2 standard

T2200SX, *Toshiba*

HP Apollo Series 9000 Model 42, *Hewlett-Packard*

SoundBlaster Pro, *Brown-Wagh Publishing*

HP ScanJet IIc, *Hewlett-Packard*

Lotus Notes 2.0, *Lotus Development*

CodeBase 4.2, *Sequiter*

MultiAccess Series 3000, *Advanced Logic Research*

FoxPro 2.0, *Fox Software*

GeoWorks Ensemble, *GeoWorks*

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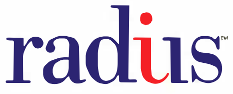




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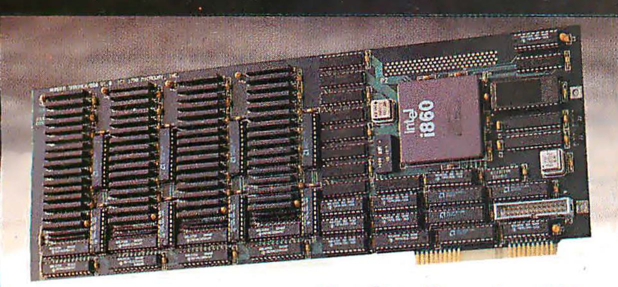
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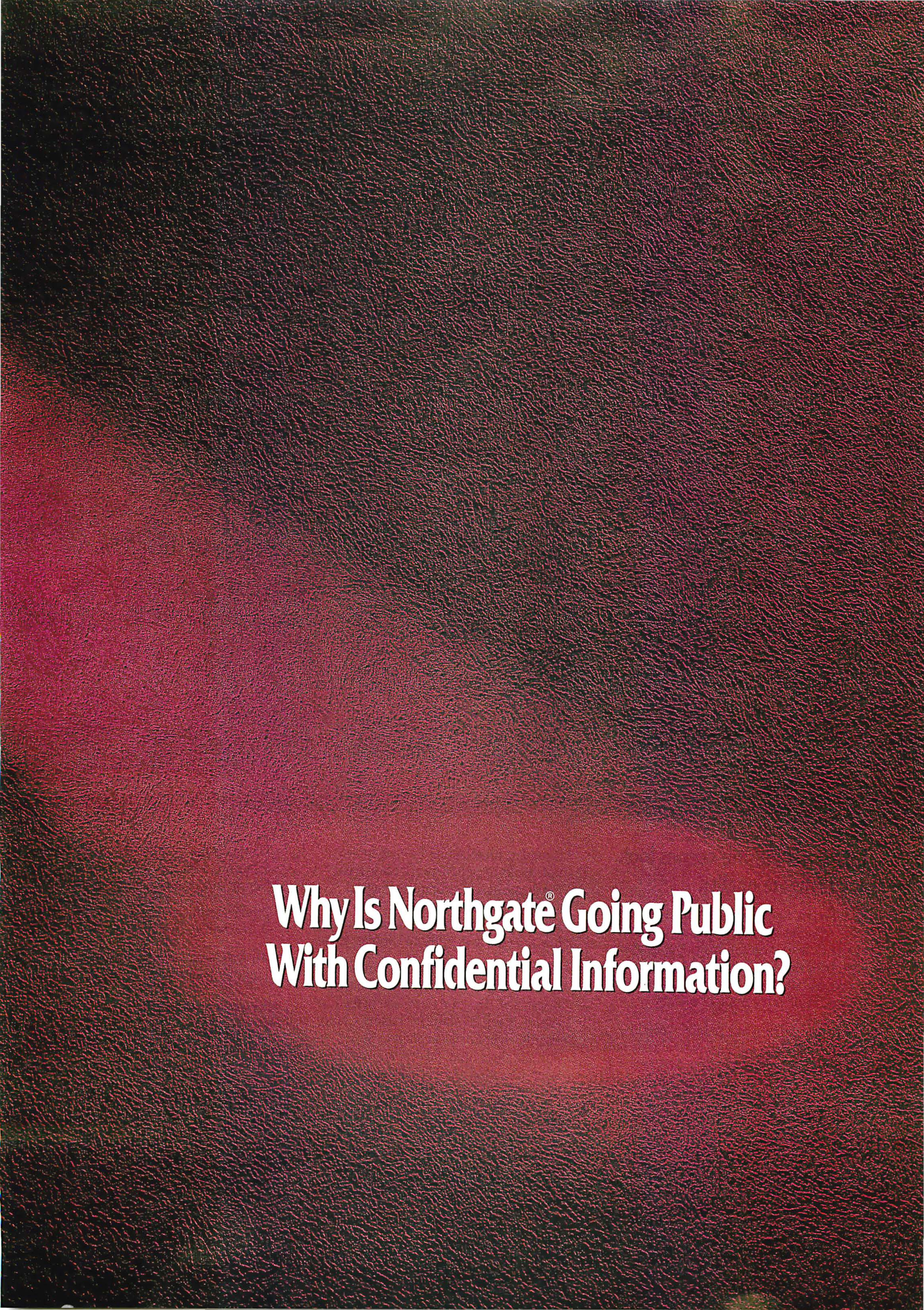
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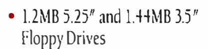
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CLASSIC LANGUAGES, PART 5

SNOBOL

A classic language for character-string manipulation

DORIS APPLEBY

Of the languages considered so far in this series—FORTRAN, COBOL, Lisp, and APL—each has associated with it a published standard that has been agreed upon by the interested parties and approved by the ISO. The main purpose of such standardization is portability: Any program conforming to the standard will compile and run, producing the same results, regardless of the language implementation you use.

SNOBOL, on the other hand—a language that implements pattern matching—has neither a standard nor any group working toward such uniformity, and it still has one version in the public domain. According to Ralph Griswold, one of SNOBOL's inventors at Bell Labs in 1962, it was named as a joke. His coworker, Dave Farber, believed that this new language didn't have a "snowball's chance in hell" of surviving. Thus it was named SNOBOL. Later, a phrase—String-Oriented Symbolic Language—was thought up that made the name into an acronym. To some of the personnel at Bell Labs, the name SNOBOL was an improvement over the language's former name, SEXI, but the puns have continued, with other versions named ELFBOL, SPITBOL, and even SLOBOL.

Who Uses It?

SNOBOL is used largely as a research tool, rather than for commercial applications. Daryl Gibb, a computational linguist, has written SNOBOL programs for clients here and abroad. He carried out one of his latest projects at the Moscow Linguistic University, where a thesaurus based on Margaret Thatcher's public speeches was being developed. Before that, he spent two years in Finland developing bilingual dictionaries. Another of his SNOBOL applications reformats publisher's files into dBase III format. It took him about a month to write SNOBOL code for this last application, but Linguatech of Orem, Utah, expects to spend about a year rewriting the code in C for a marketable product.

Zonda Freese, a student of Alan Forte at the Yale School of Music, uses SNOBOL to analyze posttonal (not based on any fixed scale pattern) music. Using the Mengelberg coding system, which translates two-dimensional music scores into conventional computer-readable strings, Freese's programs pick out hexachords (six notes) from a score and break them down further into trichord (three-note) subsets. Forte has devised a method of grouping trichords into sets called *genera*. He did much of the analysis for his book *The Structure of Atonal Music* (Yale University Press, 1973) in SNOBOL3. He has since switched to SNOBOL4 and finds that SPITBOL (for speedy implementation of SNOBOL), which is compiled for 386 and 486 machines, eliminates the problems of slowness encountered with the interpreted SNOBOL code.

The analysis of literature sometimes involves, for example, word counts and typical sentence length or the development of concordances, dictionaries, and thesauri. SNOBOL is the language of choice for such activities. It is also useful for comparative language studies or the development of computer-assisted instruction. There is no other computer language whose string-handling capabilities approach SNOBOL's level (except, perhaps, its successor—Icon).

None of these linguists, musical theorists, and language experts have found SNOBOL a difficult language to master, even though their prior computer experience was either minimal or nonexistent. Computer experts also find SNOBOL useful when a job involves pattern matching. Database programs do not always provide the particular procedure you might want, but writing a quick SNOBOL program to reorganize a text file will often prove productive.

BYTE ACTION SUMMARY

If your work is primarily with analysis of text or languages, then SNOBOL or one of its descendants is the language for you. It is unique in its use of the pattern as a data type.

continued

Listing 1: *An example of SNOBOL using tables and arrays. The spaces in the SNOBOL program are all meaningful—especially those at the beginning of lines.*

```
1.        &TRIM =1
2.        UCASE ="ABCDEFGHIJKLMNOPQRSTUVWXYZ"
          LCASE ="abcdefghijklmnopqrstuvwxyz"
3.        WRDPAT=BREAK(LCASE) SPAN(LCASE "-'") . WORD
4.        TALLY =TABLE()

*Read a line, convert uppercase letters to lowercase
5. READ   LINE  =REPLACE(INPUT,UCASE,LCASE)   :F(SORT)

*Get and remove next word from LINE,
*place in variable WORD
6. NXTWRD LINE   WRDPAT =                     :F(READ)

*Increment the count for this word
7.        TALLY[WORD]   = TALLY[WORD] + 1    :(NEXTWRD)

*Convert the table to an array, and sort the words
8. SORT   RESULT=SORT(TALLY)

*Display the results
9.        OUTPUT="Word Counts"
                 I=1
10. PRINT OUTPUT=RESULT[I,1] " - " RESULT[I,2] :F(END)
                 I=I + 1                       :(PRINT)
     END
```

Data Types and Patterns

The basis of SNOBOL is its three data types: integers, reals, and patterns. This last type defines a class of strings, with substrings matching the pattern. If a pattern is defined as `PAT = 'A'`, any string containing an uppercase *A* would be included in the class of strings containing `PAT`. The following are two types of statements involving patterns:

```
[label] subject pattern [:goto]
```

and

```
[label] subject pattern = [pattern to be substituted]
```

If the *`pattern`* is found in the *`subject`* string of the first type of statement, the match succeeds; otherwise, it fails. The *goto* can be `:(label)`, `:S(label)`, or `:F(label)`, where the *`label`* indicates where program control continues unconditionally or upon success (`S`) or failure (`F`) of the match. If the *goto* is omitted, execution defaults to the next line of code. In the second type of statement, if the *`pattern`* is found in the *`subject`*, *`pattern`* is replaced in *`subject`* by *`pattern to be substituted`*. If there is no *`pattern to be substituted`* after the `=`, *`pattern`* is deleted from *`subject`*.

Associative Features

Associative programming involves the association of objects with other objects in an arbitrary way. The simplest associative feature of SNOBOL is its ability to assign objects of any type to any variable. But two more unusual associative features are the *indirect reference operator*, $, and an array with completely unrestricted indexes, called a *table*. The SNOBOL fragment

```
X = 'Y'
Y = 'Z'
```

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```
Z = 'Julie Andrews'
OUTPUT = $$X
```

will produce `Julie Andrews`.

A table differs from an array in two important ways: First, a table's size is not fixed, and its indexes can be anything—not just integers, as in an array. Listing 1 is an example of tables and arrays. An example of output is

```
Word Counts
a - 147
able - 18
above - 3
aren't - 2
```

SNOBOL has a variety of useful housekeeping functions for dealing with textual input and output. One of these, `&TRIM`, is a toggle function. When `&TRIM` is set to 1, trailing blanks are removed from any input. `UCASE` and `LCASE` are strings of possibilities for the built-in function `REPLACE`, which will scan and replace uppercase letters with lowercase letters in the entire input line `LINE`. `BREAK(LCASE)` matches up to—but does not include—any character in `LCASE`, and `SPAN(LCASE "-'")` matches the longest subsequent string of lowercase letters, including possible hyphens or single quotation marks. Thus, `WRDPAT` will match a single word in `LINE`. Lines 5 and 6 form a loop, which transfers to line 8 when `INPUT` fails. Lines 6 and 7 also form a loop, which returns to line 5 at the end of each line. These loops behave like

```
while not EndOfFile do
  while not EndOfLine do
    for each word do
      Tally word.
```

As the interpretation of the program progresses, `TALLY` acquires as indexes the words from the input file, with values that are equal to the frequency of each word. The built-in function `SORT` converts the table `TALLY` into a fixed-size 2-D array with integer indexes called `RESULT`. An element of `RESULT` will be `RESULT[i] = (word, frequency)`, with sorting on *word*. Note that `RESULT` was created at run time, after the size of `TALLY` became known.

History

The SNOBOL language was designed to process nonnumeric data, including text and symbolic expressions, and it was a first. Its pattern-matching facilities remain unsurpassed by any language today. Areas of mathematics such as algebra, calculus, and graph theory include methods that follow rules—for example, $(x + 1) \times (x + 2) = x^2 + 3x + 2$. Such computations should be easily solved by computer, but because they are symbolic problems rather than numeric problems, they are good candidates for SNOBOL rather than a numeric-intensive language like FORTRAN.

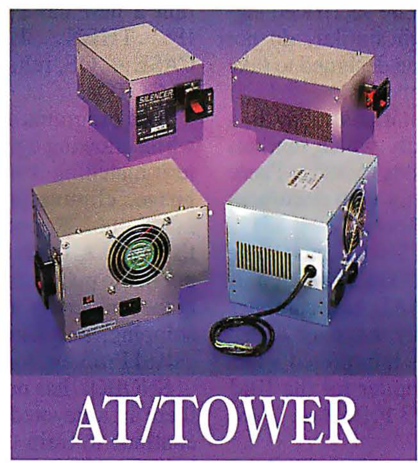
The designers of SNOBOL chose the string (i.e., a sequence of characters) as their fundamental data type, because almost anything can be considered a string, including all existing computer programs. One of the first practical applications for SNOBOL was to generate a FORTRAN program to analyze telephone networks.

SNOBOL matured at Bell Labs through three versions, with SNOBOL4 in 1967 representing a marked change. It was designed using string macros, which realized a virtual SNOBOL machine that could be implemented on a variety (at that time) of

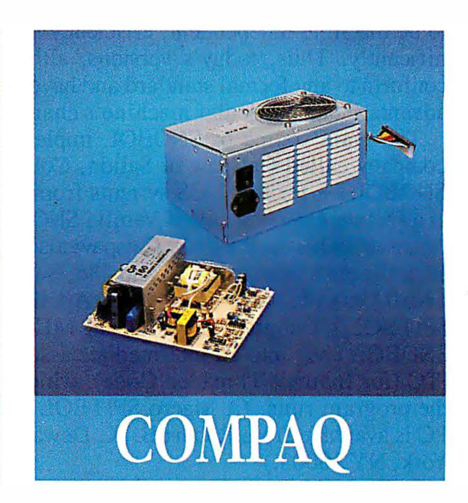
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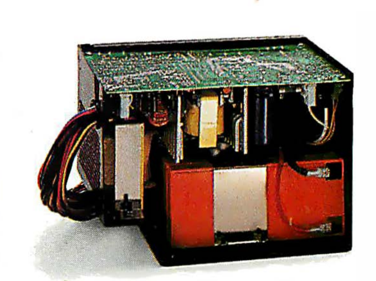
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mainframes. However, when a language like SNOBOL4 tries to be machine independent, efficiency must be sacrificed significantly. Thus, today's versions, although similar, do not conform to any formal standard and have been designed to take advantage of a particular machine's characteristics.

The main source of SNOBOL implementations today is a company called Catspaw of Salida, Colorado, which markets SNOBOL4+ for MS-DOS systems from 8088s to 486s. There is a freeware version called Vanilla SNOBOL4 with documentation included on the disk. Catspaw also offers a 32-bit SPITBOL for the Macintosh, 386 and 486, Sun-4/SPARC, and some 680x0 Unix platforms, such as the Apollo 3000 and the Sun-3. SPITBOL's compiler is written in MINIMAL and compiles SNOBOL code into an intermediate assembly language called ITC (for Indirect Threaded Code), which is interpreted when the program runs. (A Macro SPITBOL compiler for the IBM PC is available from Robert B. K. Dewar, 73 Fifth Ave., New York, NY 10003.)

I talked with several researchers in the humanities who claim that much of the success they have had with SNOBOL is due to Mark Emmer, president, consultant, hand-holder, and chief guru at Catspaw. He persists, as he says, "out of love and loyalty to the language," and, I might add, to his customers, for whom SNOBOL remains the language of choice.

Icon

Griswold, who has always been a researcher rather than a language developer, has moved on to develop a SNOBOL successor, Icon, that continues the emphasis on string manipulation and pattern matching but differs enough from SNOBOL to warrant a new name. He has added control structures, such as IF...THEN...ELSE, WHILE...DO, EVERY...DO, and CASE...OF, removing the need for SNOBOL's heavy reliance on GOTOs.

Icon programs are broken into procedures as in Pascal or C, while allowing a process to succeed or fail as in SNOBOL. Pattern-matching functions have been fully integrated into the language, eliminating the need for declaring patterns such as `LCASE`, `UCASE`, and `WRDPAT` in the SNOBOL program shown in listing 1. All versions of Icon (the current one is 8) have been put in the public domain and are available from the Icon Project at the University of Arizona for essentially the cost of copying, shipping, and handling. Catspaw also has a version of Icon, called ProIcon, for the Macintosh.

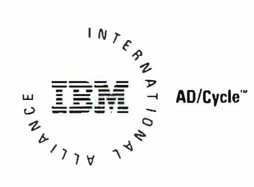
SNOBOL has never been much of a commercial success, but there is a devoted and long-lasting community of users who continue to train their followers in SNOBOL as well. Emmer believes that Griswold and his colleagues created in SNOBOL a language that parallels the workings of part of the human brain. It seems to parallel the associative and intuitive aspects of human thinking. ■

Doris Appleby writes about mathematics, computer science, and pedagogy. She is also the chairperson of mathematics/computer science/information systems at Marymount College in Tarrytown, New York, and the author of Programming Languages—Paradigm and Practice *(McGraw-Hill, 1991). You can reach her on BIX c/o "editors."*









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LOOK WHO'S TALKING

HEWLETT-PACKARD

HP has developed a network trouble-shooting tool called the Network Advisor. The Network Advisor offers a comprehensive set of tools including an expert system, statistics, and protocol decodes to speed problem isolation. The NA user interface is built on a windowing system which allows multiple applications to be executed simultaneously.

NCR

NCR has an integrated test program development environment for digital, analog and mixed mode printed circuit board testing.

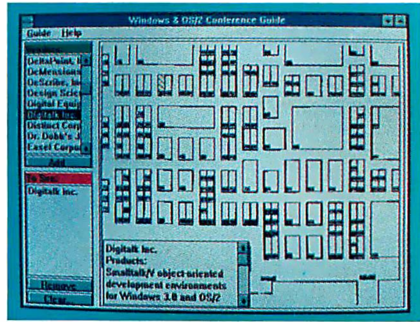
MIDLAND BANK

Midland Bank built a Windowed Technical Trading Environment for currency, futures and stock traders using Smalltalk/V.

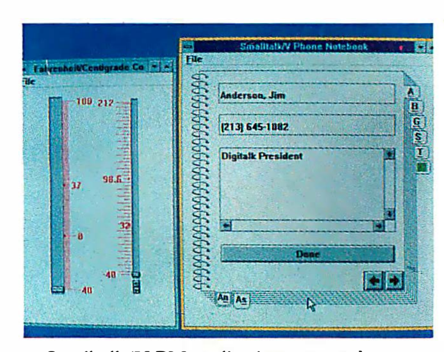
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KEY FEATURES

- World's leading, award-winning object-oriented programming system
- Complete prototype-to-delivery system
- Zero-cost runtime
- Simplified application delivery for creating standalone executable (.EXE) applications
- Code portability between Smalltalk/V Windows and Smalltalk/V PM
- Wrappers for all Windows and OS/2 controls
- Support for new CUA '91 controls for OS/2, including drag and drop, booktab, container, value set, slider and more
- Transparent support for Dynamic Data Exchange (DDE) and Dynamic Link Library (DLL) calls
- Fully integrated programming environment, including interactive debugger, source code browsers (all source code included), world's most extensive Windows and OS/2 class libraries, tutorial (printed and on disk), extensive samples
- Extensive developer support, including technical support, training, electronic developer forums, free user newsletter
- Broad base of third-party support, including add-on Smalltalk/V products, consulting services, books, user groups



This Smalltalk/V Windows application captured the PC Week Shootout award—and it was completed in 6 hours.



Smalltalk/V PM applications are used to develop state-of-the-art CUA-compliant applications—and they're portable to Smalltalk/V Windows.



ILLUSTRATION: JIM LUDTKE © 1992

A MOVING TARGET

Windows, Macintosh, assorted Unix flavors, and GUIs—how do you deal with all the platforms that make up today's computing environment?

BOB RYAN

Developing computer applications used to be a breeze—relatively speaking. Back when *computing* was synonymous with IBM 360/370 mainframes, MIS organizations and commercial developers didn't have to worry about supporting multiple platforms for their software—most computing environments were homogeneous and proprietary.

Today, the situation has changed radically. Organizations typically employ a smorgasbord of computers—micros, minis, and mainframes—from many different companies running lots of different operating systems. This situation makes developing and supporting mission-critical applications a daunting task. Cross-platform development has become a way of life for MIS departments and commercial developers alike. Too often, however, it is a way fraught with setbacks and peril.

This article and the two that follow it examine many of the aspects of cross-platform development in the 1990s. No longer is it enough to have a standard compiler for each platform. As complex GUIs and distributed processing take the place of character-based PCs and dumb terminals, the problems of supporting a heterogeneous environment grow exponentially. The challenge is to develop a cross-platform strategy and acquire a standard set of tools that can deal with multiple platforms and let you adapt to rapid changes in technology.

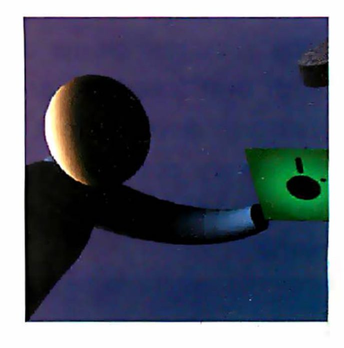
As the Intel/IBM/Microsoft monolith fragments and more and more applications migrate from the "big iron" to the desktop and LAN server, confusion will reign both in the marketplace and inside organizations of all sizes. The ability to make sense of the results will differentiate the winners from the losers.

Issues and Answers

Cross-platform development encompasses so many different ideas that it is impossible to define simply. In its purest sense, it means writing programs that perform the same functions on different hardware and operating-system platforms. As networks become more pervasive and organizations become more thoroughly connected, the need for different applications to share common data or even common computing resources will grow in importance. Cross-platform development will become an integral part of any cooperative or distributed-processing environment.

One major issue in development across various types of systems is how to develop applications that will run identically—or nearly so—on several different platforms. Many large commercial developers have multiplatform marketing strategies: They support as many different popular platforms (e.g., DOS, Windows, Macintosh, and Unix) as their resources permit. Consequently, their cross-platform development tools and tactics have become strategic assets. The ability to deliver applications for many different platforms in a timely manner gives a company a major competitive advantage: Its applications have lower development costs, and they are quicker to market.

For example, Lotus Development (Cambridge, MA) has stated that it intends to make its flagship product, Lotus 1-2-3, available on all major computing platforms. At first, Lotus went with a straight porting strategy to achieve this goal,





with software engineers translating code developed originally for the DOS environment to run on other platforms. It wasn't too long before the company realized that straight ports were not the way to achieve a reasonable time to market. Lotus decided that it had to build cross-platform capabilities into its code.

According to Eileen Rudden, director of spreadsheet marketing for Lotus, the company uses one code base for Lotus 1-2-3, with a high percentage of the code shared among different versions of the program (the exact percentages are a trade secret). Lotus is building a development environment that consists of a set of high-level application programming interfaces (APIs) that access a platform-specific layer above the core application. Platform-specific functions provide the glue between Lotus 1-2-3 and the different platforms. All custom development takes place at this layer.

As Rudden puts it, "The application itself is not ported. Our energy goes into the platform-specific layer. The reason we can do it this way is that we've engineered our application to recognize that certain services are handled differently on different platforms." So, Lotus takes a proactive approach to cross-platform development. It starts with an application that is "cross-platform-aware" so that it can devote its energies to refining the platform-specific parts.

Of course, even the best cross-platform development system can't save you if you misread the market. Lotus is currently playing catch-up in the booming Windows software market—not because of any major weakness in its cross-platform efforts, but because it made an early commitment to OS/2 and Presentation Manager (PM). Only after seeing that the business world was choosing Windows over OS/2 by a wide margin did Lotus give priority to its Windows development efforts.

Wolfram Research (Champaign, IL), publisher of Mathematica, is another company that pursues an aggressive multiplatform strategy. Wolfram supports dozens of different platforms by cleanly separating interface code from the computational engine. The result is a system that makes it possible to automatically update and maintain versions of a program for many different platforms (see the text box "Concurrent Multiplatform Development" on page 162 for more details).

BYTE ACTION SUMMARY

In today's multiplatform world, you can no longer write for one platform and ignore the rest. We all want the freedom to put our favorite type of system on our desk. With that freedom, cross-platform development is a necessary complication of the modern computing world.

Local Concerns

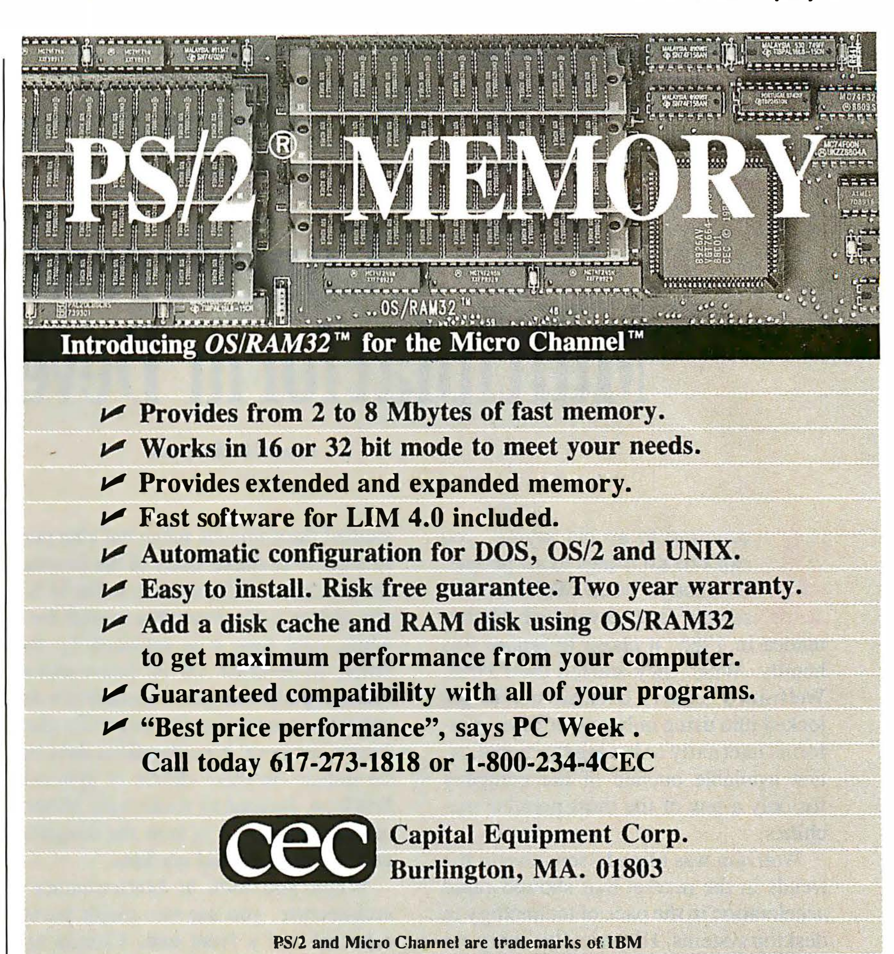
Cross-platform development is not the exclusive domain of big-time commercial developers. In-house developers also must suppport many different desktop standards. The days when MIS departments dared—or cared—to dictate one hardware standard and one operating-system standard for every desktop in a medium or large organization are rapidly disappearing. The computing infrastructure in most companies consists of a heterogeneous mix of desktop platforms and networks. With end users clamoring for greater access to data repositories from their desktops, many MIS departments confront the task of supporting a variety of platforms in their in-house development efforts.

When developing across platforms, you have to decide how closely you wish to support the native environment of each one. This is a concern mainly for in-house developers; commercial developers who don't fully support the interface standards and capabilities of different platforms usually find a limited demand for their products.

On the other hand, in-house developers have a choice: They can adhere to the standards of each platform, or they can try to make their applications appear the same on every platform. The approach you take depends entirely on the goals of your organization and the needs of its end users.

If, for example, it is the goal of your company to supply the same interface to corporate data from every desktop to save on training and software-support costs, you'll want to create a common interface across platforms. But if seamless integration of in-house and commercial applications on each platform is the stated goal, you'll have to tailor in-house development to the needs of the different supported platforms.

The decision may come down to the



relative importance of commercial and in-house applications in your computing environment. If most of the work in your organization is performed with commercial tools, you'll probably want a "go native" cross-platform strategy. If most people are running homegrown applications, the one-size-fits-all strategy may be the way to go.

Two Looks for Smalltalk

The strategies employed by the two principal publishers of Smalltalk illustrate these two distinct approaches to cross-platform development. ParcPlace Systems (Mountain View, CA) takes the approach that an application should always look exactly the same, regardless of the platform on which it is run. Digitalk (Los Angeles, CA) approaches the problem differently. It believes that an application should reflect the standard interface and use all the special facilities of each specific platform. Assuming that you use either ParcPlace's or Digitalk's version of Smalltalk to develop your applications, you will, by default, adopt that publisher's philosophy.

If you choose ParcPlace's Smalltalk, your porting work will be essentially complete once you have written your application on one machine. Your Smalltalk code will look and operate the same on any machine that has ParcPlace's Smalltalk. The price you pay for this convenience is the difficulty you encounter in taking advantage of the special attributes of the host platforms. For example, it is not a trivial task to take complete advantage of Windows dynamic link libraries (DLLs) with ParcPlace's Smalltalk.

Having your application always take on the ParcPlace look has advantages and disadvantages, depending on your reasons for developing on multiple platforms. If you are porting a commercial application from Windows to the Macintosh, you want your application to follow the Macintosh style guidelines: You want your Macintosh version to look and act like all other Macintosh applications. After all, the common look and feel among Macintosh applications is a major reason for the machine's success. But if your application is developed with ParcPlace's Smalltalk, your program will look like a ParcPlace program running inside a Macintosh window—kind of a kludge.

On the other side of the argument, once people have learned to run a ParcPlace application on one system, they are totally familiar with it no matter what system they happen to be using. This cuts down on retraining. The ParcPlace philosophy is attractive if your application is for in-house use, especially if your "house" uses many different kinds of systems. You can train users for all systems in the same course.

If, however, you choose Digitalk's version of Smalltalk, porting an application can require a major effort. After you have written the code that is common to all computer platforms, you then have to write separate code that takes advantage of each of the distinct operating systems and user interfaces of the individual platforms.

On the bright side, Digitalk's class designs reach deep into each host's GUI and operating system with common methods and classes, but you still have to write some of the expected behavior methods for each environment. On the dark side, Digitalk itself has become victim to one of the pitfalls of cross-platform development: It has not produced concurrent revisions for all the platforms that it supports.

The Impact of GUIs

One reason that cross-platform development has grown more complex in the past few years is the growing demand for applications to sport a graphical interface. GUI applications are inherently more difficult to develop—and hence to port—than are text-based applications. Mastering a single GUI is difficult enough for an individual or an organization; mastering multiple GUIs is even more difficult.

As a consequence, a number of companies provide toolkits to aid in developing cross-GUI applications. These toolkits are analogous to the cross-platform compilers and assemblers that were the only cross-development tools you needed when the computer world was younger—and the choices fewer.

The best known of these toolkits is the Extensible Virtual Toolkit (XVT Software, Boulder, CO). Consisting of C libraries for Windows, Motif, PM, Macintosh, and character-based interfaces, XVT lets you write an application once and compile it on the different target platforms. In effect, you write to the XVT API rather than to the individual target APIs.

Tools like XVT have a common shortcoming: the least common denominator. Creating a portable library that accesses the functions of many different GUI platforms means that you can include only those elements that all the platforms share. The platform-specific functions and features (e.g., the DLLs of Windows or Publish/Subscribe on a Macintosh) must be added after the common application is built. For in-house development, the least common denominator approach

Concurrent Multiplatform Development

Janet J. Barron

According to an old saying, you can't be all things to all people. Evidently, when Wolfram Research first developed Mathematica in 1986, it chose to ignore this homily. When they started their firm, Wolfram's leaders decided not to get locked into using only two or three platforms internally or having their application available outside of the company for only a few of the most popular machines.

Wolfram was already sensitive to the trends in the market that showed rapid acceleration in the pace of technology in desktop systems. Historically, every six months there is a new generation of machines with a new level of performance. The firm wanted to make sure its software would continue to be consistently compatible with the technology as it changed.

Market Requirements

Looking at its primary potential customers—scientists, educators, and engineers—Wolfram noted that people in these disciplines are not bound to one machine. They might use one machine in their office, another at home, and a combination of systems in the laboratory. It made sense to provide them with the flexibility to develop a Mathematica application on one machine and to be able to run it on another.

Prem Chawla, chief operating officer of Wolfram, says that before it came out with Mathematica, Wolfram not only studied the domestic scene but also performed an in-depth study of the international market. It found that, in the U.S., one platform dominates the market for a while, and then it is replaced by another. In contrast, in the international market, people in specific countries develop a consistent loyalty to certain platforms; temporal considerations have little impact on their choice of systems. Wolfram decided to make sure Mathematica was useful in both the domestic and the international markets.

When you look at Mathematica's architecture, you see two major parts, a kernel and a front end, Chawla explains. "The front end is very specifically machine-bound; the kernel is very portable. The way we made it very portable was to use dual coding—reasonably modular techniques. At the same time, we coded the kernel in C so we could take it from machine to machine.

"Both the kernel and the front end are very discrete pieces, and they don't have to run on the same machine. The front end can take advantage of a specific GUI environment, such as the graphical interface of the Macintosh or Windows. If there isn't a GUI environment available on a platform, we provide an X Window System–based interface that is consistent across the board."

The cost of porting to many machines is quite high, Chawla explains. "Basically, we do primary development of the code on Sun and Next machines. In 1986, when we started this project, we set up a network of all the various platforms. Every night, after our developers have added new functionality and features, the changes are compiled on the Sun. Immediately, new versions of the software are built on all the different platforms. Every day, we can literally have a new version of the product that was created automatically the night before."

According to Chawla, this approach to cross-platform applications development provides major benefits to the customer. "If you want to use Mathematica," he says, "you don't have to worry about the hardware—you'll be hardware independent. With new hardware, you can get up to speed fairly fast, and you can keep up with the technology. You don't have to be stuck with old technology."

With Mathematica, the kernel that runs on one machine is the same kernel that runs on another. Every machine has the same functionality. Files that are supported by Mathematica are all text-based, so you don't have to do any file conversion from one platform to another.

"Another reason our front end plays a very important role," says Chawla, "is that one of our front-end design criteria was that you should be able to take what is created on one platform—say a Macintosh—load it on a Windows platform, and run it without any change.

"Suppose you are writing a technical report in Mathematica on a Macintosh

may be OK, but for commercial development, it usually isn't.

Beyond cross-platform toolkits lies the realm of cross-platform operating systems. In the past year, a slew of initiatives, consortia, and joint ventures have cropped up that promise to provide cross-platform interoperability between industry-standard Intel-based PCs and one or more of the latest RISC platforms (see "Let the System Do the Porting" on page 191). Pink (the Apple-IBM joint venture), the Advanced Computing Environment (with Mips, Microsoft, DEC, Compaq, et al.), and Solaris from Sun Microsystems all promise cross-platform interoperability, but who is going to provide interoperability *among* them?

Pulling Together

Beyond running the same application on different platforms, cross-platform development has also invaded the domains of cooperative and distributed processing. Before computing environments became heterogeneous, computing over a network was a challenge; today, it can be a nightmare. Even here, however, a new generation of tools is making it easier to share data and computing cycles.

In its simplest definition, *cooperative processing* describes the sharing of data by many computers over a network.

and you want to distribute that report in electronic form to your colleagues who have IBM PCs running Windows. They can take that format as it comes out and run it, because they will get exactly the same graphics, equations, scientific text, and compound documents—all the things you have created on the Macintosh."

Build and Test
Rory Murtagh, Wolfram's director of engineering, addresses some other issues associated with in-house and external cross-platform development efforts.

"In-house," says Murtagh, "we run on about 30 platforms, most of them Unix, a few DOS. A couple of platforms that we dial out to are Convex and Alliance, and we contact them by Internet 2. In-house, all our machines are connected by Ethernet. For DOS machines, we use PCNetwork File Server, which shares Unix file systems with PCs. On the Mac, we do equivalent things on the Hierarchical File System.

"Our core product consists of about 300,000 lines of source code—that comes out to one large binary [file] and several small binaries. We have a public domain software-control system called Revision Control System. RCS keeps a history of added changes to the source code files so we can progress and regress.

"In the Unix environment, the RCS builds a new binary nightly. More than 20 machines concurrently update their own copies of the source codes; they synchronize a local copy of the source codes with a master copy and build a new version of the product. Then, our software engineers can test it on any platform with the latest copy. By building it as frequently as possible, it will show machine-specific problems right away, because it will fail to compile."

An early method Wolfram employed was to build on the same file system using a network. When this procedure was performed several times simultaneously using a shared file system, however, the network bogged down. A year and a half ago, the firm changed to its current method, which is working fine. "Some other software houses—such as Lotus, Microsoft, and Oracle—do this number of platforms, but most vendors do only a few," says Murtagh.

Regarding upgrading Wolfram's system, Murtagh explains that if the firm had unlimited funds, it would use software network technology (e.g., Fiber Distributed Data Interface), but that technology is still very expensive.

"We are dealing with concurrent development. Several developers can work on the same code at the same time using Concurrent Version System, which runs on top of RCS. We are just beginning to use it, but it's a definite improvement.

"Earlier, Wolfram had one canonical source code, and several developers would work on it. Theoretically, one developer could preempt the others. Now, each developer gets a copy of all the source codes (one person works on a particular algorithm) and has to wait until that copy is in a consistent state and is ready for testing. Then those changes are committed to a central repository.

"If more than one person is working on the same part of the code, the system will warn them and help merge the two [sets of] changes. This process is much better than it was when we were constantly overwriting each other's work or when we had to lock our files. You want to make point changes to many source code files, particularly in porting. Logistically, that was kind of a problem."

Janet J. Barron is a technical editor for BYTE. You can reach her on BIX as "neural."

When every computer in your department or enterprise shared the same architecture and operating system—and was connected by a single-protocol network—cooperation between applications that accessed the same body of data was not too difficult. Today, sharing data over a network is more of a challenge, although the rewards can be well worth the effort.

Cooperative processing in practical terms means common access to a relational database that resides on one or many servers. These servers can be other workstations, a LAN server, a large minicomputer, or a mainframe. Today, the most popular way to access a relational database is via Structured Query Language.

SQL is a nonprocedural language used to create and access relational databases. It is supported by all major database

The Vertical View

Most of us take a horizontal view of cross-platform development. We worry about getting the same software up and running on both a Sun workstation and a Windows-based desktop PC. Such concerns can seem positively provincial when you consider the cross-platform dilemma facing MIS organizations. Their concerns are more universal in scope: how to create and maintain software systems that span the gaps among mammoth mainframes, slick personal computers, and workstations.

John Tibbetts sees these concerns firsthand. He is a principal of Kinexis, a San Francisco-based consulting firm that works with companies to develop cooperative-processing systems that span personal computers, LANs, and mainframes. He has a valuable perspective on the issues you face when integrating personal computers and mainframes—one that is not often heard in the community of personal computer users.

"My impression of the world right now is that we've seen the first phase of computing development, where over a couple of decades mainframe activity spread and we knew how to use only these big, centralized machines. Phase two, of course, was the personal computer and LAN revolution, which really represented a different culture—a 'power to the user' culture. That is where a lot of people still are today, certainly in the downsizing arena.

"I work with what happens next, with what happens when those two environments hit. This is more than a technical collision; it's a cultural collision. How do you put all these pieces together into unified applications that can tie into transaction-intensive terabyte databases on the one hand but still give power to the user on the other? How do you think about the roles of each platform as you proceed from enterprise server to LAN server to client?"

Enterprises and Clients

Unlike many observers, Tibbetts does not think that LAN-based client-server architectures, taken alone, are a complete solution to the problems of providing both community-level processing and corporate computing, although he does see client-server computing as a component of corporate computing. While the economics are obviously attractive, Tibbetts also sees the downside to moving all processing to desktops.

"You need to deal with environments that contain machines whose job it is to represent the concerns of the enterprise and its accompanying security and integrity constraints. You also want to incorporate the power-to-the-user movement. Personal computers and workstations have allowed individuals to exercise more initiative and creativity in solving their own problems. You have to be able to put that together into a meaningful environment without open warfare breaking out. In a lot of organizations right now, open warfare has broken out between [the Information Systems (IS) department] and desktop users.

"I have a client—one of the world's largest chemical companies—that has an old mainframe environment that isn't very responsive to its needs. The company's order volume is projected to increase by a factor of 10 over the next decade, and the current teleprocessing system on the mainframe is at capacity. The IS organization has responded by fielding a huge project to rebuild the system. It is in the second year of a seven-year study, preliminary to doing the design work that will replace the system.

"In the meantime, there is this really dynamic guy, probably five years away from retirement right now, who learned how to program Lotus a few years ago, an event that completely changed his life. He happens to be in charge of international operations at this company, and he's now brought up three countries doing order entry using Lotus 1-2-3. In my judgment, that is a completely inappropriate tool, although he solved the problem using guerilla tactics, using these very-easy-to-manipulate personal computer tools along with bulletin-board software to send the data.

"This is very typical of what you see. There are two camps at war: The personal computer people see the LAN as everything in computing, and they see mainframes—if they survive at all—serving as disk-farm handlers. Mainframe people look at the same platforms and see the mainframe as everything, and they look at the personal computer as a way to put pretty new front ends on [the mainframe]—but don't let personal computers get near the data. The idea is to build a negotiated settlement between the two environments."

Tibbetts sees the need for organizations to determine what is the best role for all types of platforms in an organization. In his view, desktop computers and mainframes have very different but complementary roles.

"At one extreme, you have highly trusted back-end community processors whose job it is to hold the enterprise data, something everyone recognizes as important. I think that it is also the job of the back end to be a repository for enterprise *function* as well. This is less recognized right now. For example, when considering distributed databases, a lot of people view the back-end machines as exclusively database engines. I disagree with that view. In a cooperative environment, they ought to be viewed as transaction engines. They hold not only enterprise data, but also those transactions whose job it is to ensure that data's integrity. The back end does not just hold the credit table; it owns the credit-check procedure."

Freedom to the Desktop

Tibbetts adds, "At the other extreme, the client level, we have a whole culture of powerful tools and proficient users. The focus of the front end is not integrity, reliability, and security. Just the opposite: Everything about personal computers is about accessibility—even the way they are screwed together. Their beauty is that they make computing resources accessible. That's what makes them great.

"I believe that in most corporate computing environments, you want to keep those machines free. You maintain the ability to run programs of your choice,

continued

LOOK WHAT
PC MAGAZINE
HAD TO SAY ABOUT
A VERY GRAPHIC
AND RACY
SUBJECT.

The Vertical View *(continued)*

to boot up your own machine, and perhaps to have a medium such as a disk for moving data and programs on and off the machine.

"To the extent that they are free, those machines should be considered untrusted—not untrustworthy, but untrusted by virtue of their openness and accessibility. One of the flaws in the client-server model is the notion that the application moves down to where the client is. The problem is that the application is every bit as valuable an enterprise asset as is the data. It's not only valuable to keep information about how much somebody has spent; it's just as valuable—just as important as an enterprise asset—to deal with the ownership of the rule that runs a credit check. To that extent, you don't want to be putting enterprise assets onto machines that you can stick screwdrivers into, just as you wouldn't put a cash box out in the middle of a bank lobby.

"I believe it's the role of clients to be untrusted but free. Their job is to provide very high powered, object-oriented user-interface environments that send messages toward the enterprise—the mainframe or the LAN server. I label these messages PUOWs, for proposed units of work. Their role is not to participate in transactions, but to simply suggest to the enterprise that a transaction [should] occur.

"Once you make this leap, you see that you can still let the client machine be very free. You don't have to worry about viruses and things like that, because the only communication, the only hook between the client and the next level up, is a message stream that is making suggestions.

"I believe that the personal computer should be viewed architecturally as the agent of the user, not the agent of the enterprise, which is to say its job is to amplify the capabilities of the user, whether the user is smart or dumb, honest or malicious."

Where you draw the line between freedom and trust varies from organization to organization. In most instances, Tibbetts sees the trust line falling in between mainframes and micros: at the LAN server.

"That implies a couple of things. First, the LAN server should be locked up—at least that server that is the gateway to the enterprise. Obviously, you do not want to lock up a print server. Architecturally, you can do a lot of nice things if you make the LAN server trusted. For instance, you can download some of the enterprise transactional rules and have them close and quick to the clients.

"There are environments, however, where you can't trust the LAN. I've recently been looking at an environment in a government agency that has about 2000 LANs connected to a mainframe. They don't think they can administer 2000 trusted LANs. So, in that case, they've moved the trust boundary up to the mainframe.

"When we do these designs, the trust line is not static. If you move it further down toward the client, you start restricting freedom but creating more trust. You have to tune it to the type of application and the type of human structure you're modeling with the information system."

The Role of Objects

Recognizing the nature of the different platforms in a cooperative-processing environment clarifies many design issues. In the end, however, you have to implement your design. Tibbetts sees object orientation as the paradigm that will make enterprise-wide cooperative processing an attainable goal for any organization.

"The place where object orientation is so great that it has an unfair advantage over any other alternative is at the user interface. Object-oriented user interfaces are incredibly powerful. I recommend that organizations be very aggressive and use tools—Smalltalk or [some powerful object-oriented GUI builder]—that can support multiple windowing environments. It gives you enormous productivity. The closer you get to the user interface, the more aggressive you should be with objects. However, at some point in the system—usually about the LAN server area—you're going to discover that an object-oriented infrastructure does not exist for the type of community processing needed at this level."

In Tibbetts's view, the lack of a formal object-oriented infrastructure at the back end doesn't mean you should jettison the object paradigm.

"Although the formal infrastructure isn't there, object orientation is still a useful paradigm as you move away from the user interface. In fact, the easiest place to see this is at the back end of the system, where the database lives. However, I think the relational data model will be with us for a long time, because it provides unbiased views of the data. I also believe an object-oriented shell around a relational database makes a lot of sense. Many people who take an object-oriented approach to the front end are also taking a 'wrappering' approach to the relational database.

"You can create object wrappers that render a particular view of the database as a particular hierarchy and use your transaction manager to put rules and behavior around it, making a simulated object, or a set of simulated objects, that wraps the relational database. I think that's a very effective approach, and it's one that preserves a lot of the existing transactional and relational machinery—but still gives you object views of the application-building process."

Tibbetts isn't shy about his views on object orientation. As he sees it, object orientation represents the best way to create cooperative systems that span multiple platforms and meet the needs of both the enterprise and the end users. He is anything but shy about predicting the future.

"Presently, you have terrific object-oriented capabilities on the front end. On the back end, you want to keep it relational and representational. And in the middle, you have a mixed bag. As we move along in the decade, the object-oriented paradigms will eventually extend throughout. As we go more and more into distributed and parallel systems toward the end of the decade, we are absolutely going to require the object-oriented paradigm throughout."

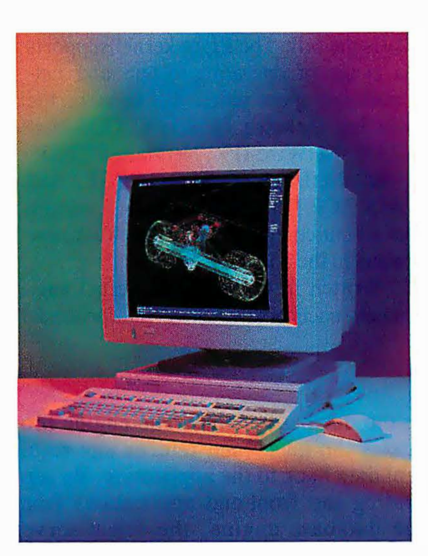
“The DECpc 433 mixes top PC performance with networking and blazingly fast video performance.”

PC Magazine
October 15, 1991



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The Third Wave

Jon Udell

New processor architectures and operating systems burst out of the starting gate each year. Time was, software developers who bet on a horse that zigged when the market zagged were ruined. That can still happen today, but, increasingly, developers are finding ways to hedge their bets.

The widespread adoption of ANSI C helped enormously. Finally, you could count on the ability to abstract programs away from the details of Intel, Motorola, SPARC, VAX, and other architectures.

Then the next challenge arose. Each platform evolved its own GUI—or several of them. ANSI C alone could not help you move programs from one GUI to the next.

Homegrown and commercial toolkits that spanned the differences between GUIs sprang up. As a result, developers now successfully field versions of their applications for two or more GUIs. Some favor C or C++ libraries and prototyping tools, and others rely on pure object-oriented programming environments. But nearly everyone sees the need to abstract away from the raw minutiae of GUI programming.

What's next? The coming challenge will be to create distributed applications that cross operating-system *and* network boundaries.

Few applications exemplify this third wave, although businesses now commonly deploy a mixture of computing resources. PCs, Macs, and workstations stand side by side and may even share common network cabling. Thanks to an emerging class of interoperability products (see "The Perfect Pitch," December 1991 BYTE), these different cultures can sometimes even emulate on another's file- and printer-sharing services. Programs that support the same file formats across different platforms (e.g., Wingz, PageMaker, and dBase) benefit accordingly.

More sophisticated and less widespread are client-server applications that depend on networked interprocess communication. Even though database vendors (e.g., Oracle) offer tools that shield developers from a certain platform's operating system, GUI, and network transports, the leverage they confer extends only to applications in the database realm.

Integrators looking for ways to deliver networked software on multiple platforms really need a general-purpose solution. Just as ANSI C adapts to 68000, 80x86, and SPARC architectures, and GUI toolkits can work with the Mac, Windows, and Motif, what's needed is a communications layer that handles IPX, NetBIOS, TCP/IP, AppleTalk, LU6.2, and other protocols.

Pipe Dream?

PeerLogic claims that its Pipes platform fills the bill. The Pipes kernel supports a range of operating-system and network-transport pairs. Up to now, the list has included DOS-IPX, DOS-NetBIOS, NetWare-IPX, NetWare-TCP/IP, OS/2-NetBIOS, SunOS-TCP/IP, and AIX-TCP/IP. An MVS-LU6.2 version is all but complete, and AppleTalk now waits in the wings.

Written in C, the Pipes kernel augments each host's native interprocess-communication services with a message-oriented peer-networking subsystem. The Pipes application programming interface (API)—just a dozen well-chosen verbs—is, as you'd expect, common to all supported Pipes platforms.

Pipes irons out the differences among transport protocols and abstracts away from the details of network programming. That means you can build a distributed application for a NetWare LAN without any references to IPX (a neat trick) and then port it immediately to a TCP/IP or NetBIOS LAN with equal disdain for the nuts and bolts of these other transports.

What's more, the same distributed application can run in a mixed environment in which DOS-IPX and Unix-TCP/IP nodes work as peers. Communicating nodes need not share a common transport protocol—and that's a major boon. Most DOS-to-Unix network scenarios, for example, rely on protocol multiplexing at each DOS node to accommodate NetWare and Unix at the same time. This side-by-side approach not only burdens DOS with extra protocol processing, but, more significantly, it does little to facilitate communication among the parallel networks.

DOS stations can have peer-to-peer or client-server relationships with Unix nodes, but only on the terms dictated by Unix—either TCP/IP sockets or remote procedure calls. Contrast this with the Pipes approach, in which a DOS node running IPX can reach a Unix node running TCP/IP through a *context bridge*. The bridge, which can be any node in a Pipes network, runs dual protocols, so the rest of the nodes don't have to.

engines in one form or another. So, it can act as a glue between front-end applications and back-end databases.

The most talked-about cooperative-processing scheme today is the client-server architecture. With this architecture, a number of different applications running on several different platforms can all access a common data repository by sending SQL queries over a network to the database engine. The engine processes the query and returns any resultant data back to the application. By separating the front-end applications from the database engine, the client-server scheme allows you to use any application to access the database—even a spreadsheet or a word processor—as long as the application can generate standard SQL queries.

Because it's a standard across all types of computer platforms (e.g., desktop machines, minicomputers, and mainframes alike), SQL has the potential to provide access to large corporate databases from PC-based applications. It is also one of the driving forces behind the downsizing movement, where core corporate applications that formerly ran exclusively on mainframes migrate to PC LAN envi-





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A particularly strategic place to locate a Pipes kernel would be in a NetWare 3.11 server. Although Novell now offers a robust TCP/IP (with NetWare NFS), a NetWare 3.11 server isn't a context bridge in the Pipes sense. DOS clients must still run TCP/IP in order to communicate with the Unix side of a mixed Unix/NetWare LAN.

That is why Novell released LAN Workplace for DOS—the company's own protocol multiplexer and DOS TCP/IP stack—at the same time as NetWare 3.11. With a Pipes NetWare loadable module in place, however, the DOS TCP/IP stack could become superfluous. A DOS-IPX node can converse with a Unix-TCP/IP node through the context bridge; each speaks its native dialect and is unaware that its partner is foreign.

The virtual network that is the set of connected Pipes nodes offers other benefits as well—notably, fault tolerance. You can have several context bridges active in a network. If one fails, message traffic automatically seeks an alternate route. Routing information is distributed everywhere, and at each of the levels of the deeply hierarchical logical network there is a privileged manager node that runs the show.

The Programmer's View

To the developer, the Pipes API looks alarmingly thin. There are verbs to register an application with the kernel, advertise a service (or "resource"), find resources advertised elsewhere, establish sessions, send messages—and that's just about it. PeerLogic points out that, simplicity notwithstanding, writing applications for a symmetrical network of peers requires a major conceptual shift analogous to the entry to GUI programming. It took us a while to get used to the idea of applications as collections of overlapping windows. It'll be a while longer before we learn to think of them as sets of communicating processes.

While conceptually small, the Pipes kernel consumes a fair bit of RAM. The current version of the DOS kernel uses 200 KB of extended memory and another 40 KB of conventional memory. That will be partly offset if Pipes saves you from loading one or more foreign transports.

Still, it is a lot for DOS to digest, particularly because Pipes' asynchronous messaging thrives best when supported by real—preferably threaded—multitasking. Even though it supports DOS and Windows, PeerLogic wisely recommends Unix and OS/2 to developers who are serious about building mission-critical distributed applications.

The AppleTalk version of Pipes has been delayed—for an interesting reason. American Express asked PeerLogic to port Pipes to IBM's MVS operating system and LU6.2 transport protocol.

Perhaps this shouldn't be surprising at all. Without a doubt, the most prevalent sort of cross-platform application today uses the personal computer as a mainframe terminal. While preserving its investment in this venerable but lopsided architecture, American Express hopes to usher in an era of more equal distribution of computational work, relying on Pipes' superior portability as a hedge against the volatility of the personal computer market.

In the meantime, despite endless talk about client-server computing, today's heterogeneous LANs often fail to add up to more than the sum of their parts. That will change when developers can routinely target their applications for the diverse networks that now wreath our desktops. Technologies like Pipes will play a key role in the transformation.

Jon Udell is a BYTE senior technical editor at large. He can be reached on BIX as "judell."

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ronments.

If the client-server architecture sounds too good to be true, that's because it is. Marvelous in theory, it is less easily implemented in practice. For one thing, not all database engines speak the same dialect of SQL—and some databases only process queries from front ends developed by the same company. In addition, you must overcome the problem of universal network connectivity before your organization can implement universal database access. Finally, there are basic security problems that must be dealt with when you try to integrate networks of PCs with a corporate data repository (see the text box "The Vertical View" on page 164).

Despite the obstacles, the client-server architecture is catching on—although more slowly than its boosters envisioned. Products such as Microsoft Excel and Lotus 1-2-3 are being built with the ability to generate SQL queries, and many companies are providing back-end relational databases that run PC-based LANs. One of the more aggressive companies in the client-server field is Gupta Technologies (Menlo Park, CA). Gupta markets query tools, applications builders, connectivity solutions, and database engines. By offering a series of gateway products, Gupta gives you all the tools you need to access an IBM DB2 database from a Windows desktop.

Sharing the Load

SQL connectivity solutions from Gupta, Oracle, and other companies make it possible to share a common database engine, but they are not capable of the more general task of sharing processing among all the computers on a network. In other words, it takes something other than SQL to create network-aware applications.

Sharing machine cycles, whether in a peer-to-peer environment or a client-server arrangement, can greatly increase the power and efficiency of a computing environment. An application can take advantage of the computing power of an entire network and access subroutines that reside on any machine. Computational servers that specialize in floating-point math or vector processing could provide services to any number of other computers. Once you step over the line into shared computational resources, you enter the domain of distributed processing.

One of the better-known tools for producing distributed applications is the remote procedure call. RPCs are conceptually simple. All programs make procedure calls; in the vast majority of cases, these procedures are contained within the calling program or are at least located on the same machine. RPCs are procedures located on different machines. They still take parameters and return results; they simply execute on some other machine that is on the network.

For RPCs to work, you need a common format for the calling application and the called procedure, and a naming service that lets the application find the proper remote procedure. Less sophisticated RPCs use early binding, where you have to explicitly state the location of the remote procedure when you compile the application. More sophisticated systems use late binding, where a naming service matches calling applications and called

Object Request Brokers

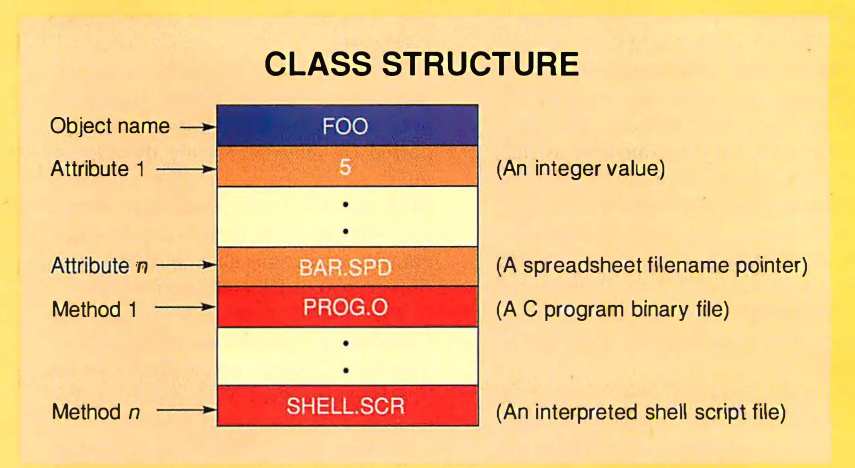
Herbert M. Osher

During the last few years, the computer industry has reverberated with news of the coming revolution in object-oriented software. The commotion has reached a crescendo over the last few months as the Object Management Group (OMG) has attempted to create a new platform standard called an Object Request Broker (ORB). What's all the fuss about, anyway?

First, you should understand what the OMG is and why its members are interested in creating object-oriented standards. Today, the OMG consists of 150 companies, mostly hardware and software vendors, as well as a small number of end users. The OMG's major objective is to work with computer industry vendors and end users to create object-oriented standards and avoid a multiplicity of incompatible systems.

One of the OMG's first forays into the standards arena was its call for submissions for an ORB. From the original 10 submissions, two became finalists. HyperDesk and DEC submitted one proposal, and Hewlett-Packard and Sun submitted the other.

The ORB has attracted so much attention because it promises to revolutionize software and the way it is created, integrated, and deployed. This technology will deliver the benefits of object-oriented development as well as those of client-server computing. Its marriage of network-based systems and object orientation will let developers create applications that are truly independent of the system and the network architecture—in effect, software without walls.



Objects of class FOO contain a number of attributes and methods. The attributes correspond to the data, and the methods are the code that acts on the data. You access and manipulate an object's data by invoking the methods.

Objects and Their Uses

Put simply, an *object* is the specific instance of a generalized software template. This template is a flexible and open-ended mechanism that describes certain data and the procedures that work on that data. The template layout (see the figure) is called a *class.* It is only when the fields in that template are filled in with specific information that you create an instantiation of the class template: the object. Therefore, a class is a description of the set of specific implementations or instances called objects.

A class template consists of a set of attributes and a set of methods. Attributes can be simple data items (e.g., integers or character strings) or more complex data (e.g., files, bit maps, or digitized voice—in these cases, the attributes are pointers to the complex data items). The methods can range from compiled subroutines written in conventional languages, such as C, to code written in interpretive languages, such as BASIC, REXX, or even shell scripts. Objects permit you to take a component approach to building large software systems. Using relatively simple and reusable objects makes it considerably easier to produce and maintain complex applications.

Distributed Object Management

The ORB represents the core of a new area of object-oriented technology called Distributed Object Management. Basically, the ORB acts like a network operating system that sits on top of any conventional operating system, such as Unix, OS/2, or DOS. It implements one basic command: EXECUTE. The format of this command looks like this:

```
EXECUTE [object_name, method,
parameter1, parameter2...
parameterN].
```

It's the job of the ORB to locate the named template (i.e., the object), start the specified operation (i.e., the method), and pass it the parameters. Because objects can exist anywhere on a network, you need a name service or a unique identifier—a handle—to locate them. If this handle is known, the object can be directly accessed.

In addition to this basic invocation function, the ORB must provide other capabilities associated with object-oriented systems. These capabilities are what make software development in an object-oriented environment as productive, maintainable, and extensible as the evangelists have proclaimed. Although these concepts have fancy computer science names (e.g., subclassing, inheritance, and polymorphism), they are simple to understand when put in the context of the software-class templates described above.

Subclassing allows you to create new

classes from existing ones. You can revise the behavior of any of the existing (inherited) methods and add new methods and attributes of your own (specialization). By doing this, you've created a new version of the class that is similar, but not identical, to the original. Subclassing lets you take advantage of an existing template—perhaps one developed for an application unrelated to your own—and modify it to suit your needs. It provides the reusability benefits of object orientation and promotes cost-effective software systems that are easier to develop, maintain, and enhance.

A slight variation on subclassing is the substitution of a different method (with the same name) for one in the original template. Because methods are invoked by name, this lets you leave an application unchanged yet still benefit from the modified behavior—be it a bug fix, an enhancement, or whatever. This process is referred to as *overloading*.

For instance, say you have a text-based template called "document" that contains a "print" method. If you copied the template for use in a graphics-based class (graphics document), you could replace the original print method with one (still called print) that knows how to output bit maps. You would invoke this new template just as you did the old one, but the behavior would change. This capability, called *polymorphism*, lets you maintain a consistent interface and hide differences in implementation. Any object-based system needs to support these capabilities.

The ORB supports these capabilities by including some primitive, or root, templates (also called *base classes*) as part of the basic ORB. Built into these base classes are methods that provide the functionality of subclassing, inheritance, and polymorphism.

The presence of base classes lets you use the EXECUTE command, which provides the basic object-oriented functions by letting you invoke a subclass or substitute method. In fact, adding more of these intrinsic operations to the base classes enhances the system's capabilities and makes them available through the same simple interface mechanism. What's more, you can now define your own functionality by adding and changing methods. Because these methods can be inherited by newly defined classes, you can create and specialize more functionality as the system evolves.

So, the ORB is essentially a control module with a simple interface for manipulating objects and a small number of operations defined by a set of base classes and their built-in methods. This is the starting point for building more complex and extensible software. One interesting point is that even these built-in objects are predefined classes (templates), manipulated by the same basic interface. Because these classes can be changed or replaced, even the system's basic capabilities can be modified and extended. This raises a couple of interesting points.

First, you need a bootstrap process that loads the initial set of classes. This capability is provided by the Genclass compiler. Second, because basic functionality can be redefined, you must establish a standard for these basic functions and classes. This is exactly the role that the OMG is expected to play. In this arena, the base classes and their object life-cycle methods are known as a *type repository*. To provide true interoperability and compatibility between different implementations of an ORB, a standard for these classes and methods is essential.

Software Without Walls

With an ORB, you have a method of accessing objects located anywhere on a network using a name service. This permits you to build complex client-server applications using objects located on network servers that you access by invoking their methods through the ORB. Building applications in this manner lets you move pieces around easily, change services without affecting the clients, create prototypes quickly, and generally attain great flexibility in building network applications.

In addition, HyperDesk envisions an ORB with the following attributes:

- A developer of the class template should be able to modify or add new code without bringing the system down or affecting applications that are already running. This is known as *dynamism.*
- A developer should be able to provide several methods (with the same name). The system would determine the proper method at run time based on user preferences, such as the machine the user is running, the language that is being used, or other cultural or system preferences.
- The user (or client application) should be able to ask the object to describe itself (i.e., its methods, parameter requirements, and attributes) so that, by exploration, you can discover new capabilities and services that can be used at run time. This is also a capability of dynamism.
- All this software should be portable across different hardware, operating systems, and networks.

The functionality provided by Distributed Object Management and the ORB reduces cost and creates more maintainable software for client-server and LAN applications, and it enables true applications interoperability across diverse computing environments. Additionally, the dynamic application-integration aspects of the software provide the developer and the user with greater efficiency and productivity.

Through the standards leadership of the OMG, the capability to develop applications that are truly independent of system and network architecture is now a reality.

Herbert M. Osher is president of HyperDesk Corp. (Westborough, MA), which develops distributed-computing software based on object management technology. You can reach him on BIX c/o "editors."

procedures at run time.

RPC toolkits are available from many sources. Netwise (Boulder, CO) offers interoperable RPC implementations for dozens of different platforms. The Distributed Computing Environment from the Open Systems Foundation (Cambridge, MA) is built on RPCs. With its sophisticated naming, time, and remote file services, DCE lets you create globe-spanning distributed applications.

Although they are extremely powerful, RPCs don't deal with the lower-level protocol issues that you must face to create network-aware applications. One innovative solution to building applications over multiple-protocol networks is Pipes. It gives you everything that you need to create LAN-spanning applications (see the text box "The Third Wave" on page 168).

Networks of Objects

Software development is hard and getting even harder. Throw in multiplatform networked environments, and it becomes almost impossible. In increasing numbers, developers are turning to object-oriented technologies to help them create and maintain usable software.

The point of object orientation is to shield developers from the incredible complexity of software systems. Using objects whose functions are well understood—but whose internal workings may be a mystery—developers can create and maintain sophisticated systems much more easily than they can with standard procedural code. This way, you need only understand *what* an object does, not *how* it does it.

Objects are showing up in many places in cross-platform environments. For example, the ParcPlace and Digitalk implementations of Smalltalk discussed earlier are object-oriented environments. In fact, one company even offers an object-oriented interface builder for ParcPlace's Smalltalk that further abstracts the problems of building a GUI for your Smalltalk applications. The Tigre Programming Environment from Tigre Object Systems (Santa Cruz, CA) enables you to create Smalltalk GUIs for many different platforms with a minimum of coding.

Given the advantages of object orientation and of distributed computing, you shouldn't be surprised that people are trying to put the two together. The Object Management Group (Framingham, MA), a consortium devoted to setting practical standards for object technology, has recently announced its choice for an Object Request Broker, which will let applications access objects anywhere on a network just as an RPC lets a program access a procedure anywhere on a network. The ORB is the first step toward the definition of a truly transparent cross-development environment (see the text box "Object Request Brokers" on page 172).

Are objects the be-all and end-all of cross-platform development? Given the enormous complications of cross-platform development and the powerful abstraction capability of objects, the answer is undoubtedly yes. The question now becomes whether it is cost-effective to move hundreds of billions of dollars' worth of software into the object-oriented realm. That answer is just as obvious—not yet. ■

Bob Ryan is a BYTE technical editor. You can reach him on BIX as "b.ryan."

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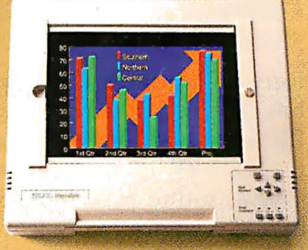
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TRIBUTARIES AND DELTAS

Tracking software change in multiplatform environments

RANDALL D. CRONK

Despite the best efforts of the computer industry's many standard-setters (official and unofficial), the world is still a dangerous place in which to write software. It is bad enough that there are still Hewlett-Packard, IBM, DEC, Sun Microsystems, Silicon Graphics, Mips, and about a hundred or so other variations of Unix to contend with—there remain all the proprietary platforms, too. Several represent huge markets, and woe to the vendor who introduces exciting new features for the Macintosh now and asks its Unix and DOS customers to wait a year.

The challenges of cross-platform development, however, do not affect just vendors, nor are they limited strictly to compatibility issues. By far, the biggest problem is code management. Anyone who has ever written more than one version of the same program knows the frustration of trying to make sure that bug fixes and updates are applied appropriately to all versions. Changes to the X Window System version of a Unix program may work in the DECwindows version of a VMS program, but not in the command-line version. The addition of TCP/IP to an E-mail application may affect different software modules for different users, depending on whether they have Chipcom, Proteon, or some other hardware.

For large development efforts, managing code for applications that run on different platforms can become very complex indeed. The definition of a platform can include not just the operating system and CPU hardware but also such things as database managers, communications servers, and math coprocessors. And

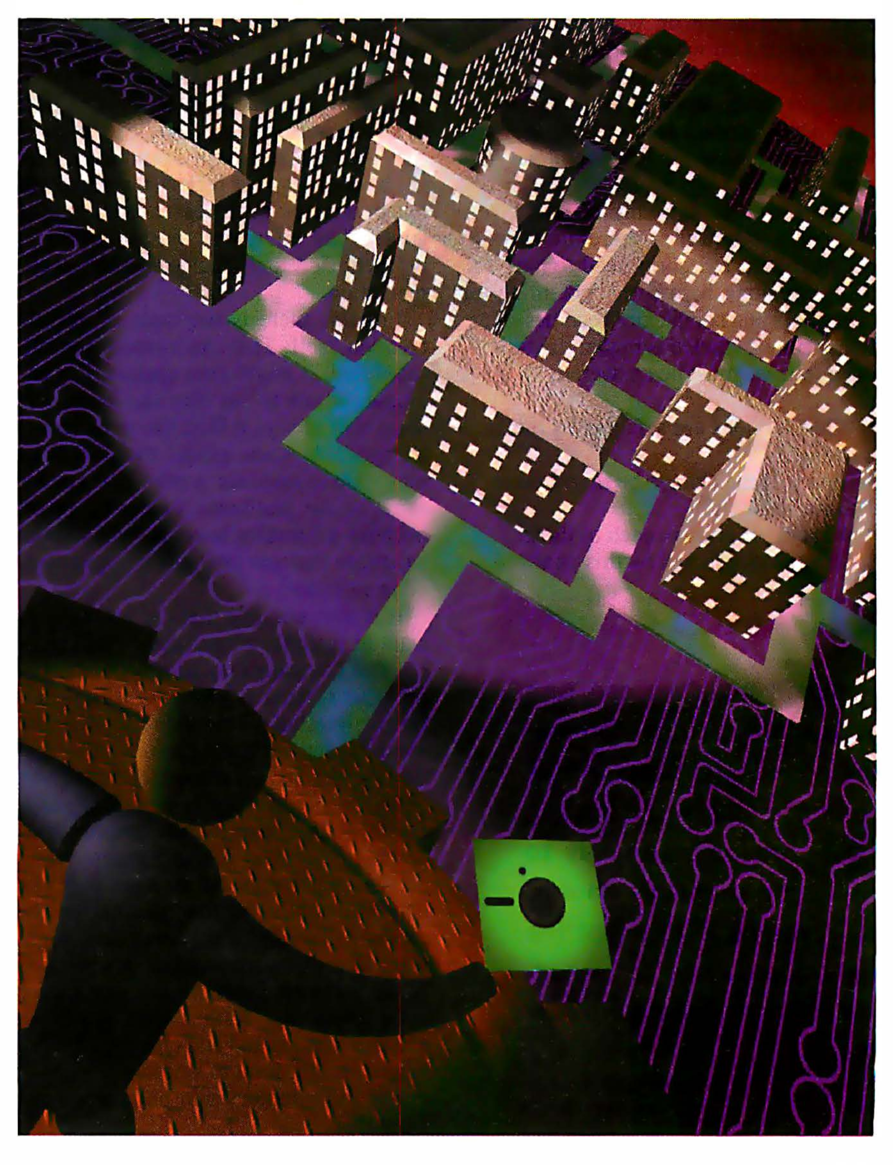


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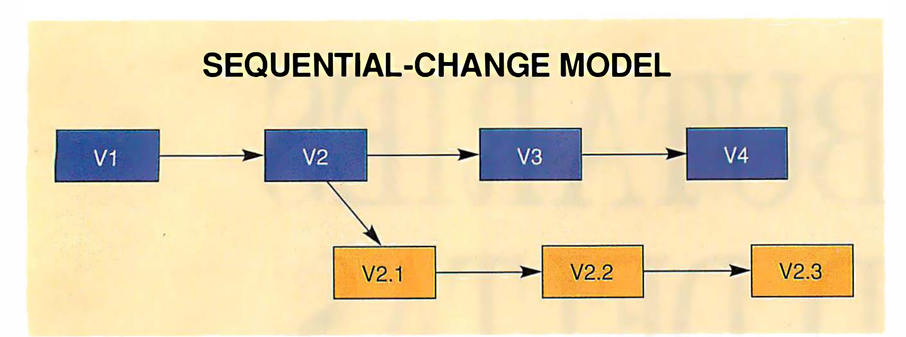


Figure 1: *The boxes indicate versions of the file. Each version is the immediate successor of the previous version. One or more logical changes are made between versions, and every version in the tree has a linear sequential history.*

these are only the technology factors. There are also nontechnology factors. These can include accounting rules, demographic preferences, legal requirements, and distribution-channel restrictions. Nontechnology factors often have a lot of influence on what features are implemented on what platforms. For example, a company might want to allow third parties to develop local variations of its DOS product in non-U.S. markets while developing all its Macintosh versions itself.

There can be as many different versions of a program as there are ways to define users. You don't need to have too many versions before the potential for overwhelming complexity becomes clear. Every time a change is made, the following questions must be answered:

- What versions are affected by the change?
- How will the change be migrated to those versions?
- What other code in each of those versions is affected by this change?

BYTE ACTION SUMMARY

Software revisions can turn your multiplatform computing environment into a frustrating tangle of conflicting code versions. The way to avoid the problems caused by revisions is to adopt the right approaches to managing software in these environments.

- What else is affected (e.g., documentation)?
- How are selected versions created from the software inventory?

The last two questions raise issues that go beyond making certain that the correct changes are successfully implanted in the right release. External dependencies (e.g., documentation) are also part of a software release. For example, if only the DOS version of a product feature is changed (say, to reflect the existence of a brand-new coprocessor chip), all the appropriate references must, obviously, be identified and changed in the documentation.

Finally, there is the issue of version creation itself. This can be more complicated than it might first appear. For example, who's to say that the latest versions will always reflect the most recent changes? At some point, the developer may want to undo some prior changes for some of the platforms supported (e.g., because a function becomes available in hardware that was previously implemented in software).

It is also possible that the vendor will want to institute a "reusable code" policy. The company may adapt code from a previous version as a base for a new platform migration. That might happen if the most recent version supports one windowing system and a new target platform calls for another that is completely different. Rather than use the existing windowing system as a development base, the developer may opt to start with the original command-line version of the product. Finally, the developer might want to create a completely new version of the software from the existing source code inventory. Rather than select an existing version and add changes, the developer might want to simply select code out of the inventory and build a version from that.

Wanted: A Good Code Manager

The general practice of keeping track of multiple software versions is known as software-configuration management. A number of automated SCM tools exist, and each one addresses some or all of the cross-platform development issues. All SCM tools share certain features. For example, they all view software development as an incremental process in which any version equals a base version and the changes. All SCM tools also exploit the idea that less storage should be required to hold one release and the changes than to hold entire copies of all releases. Saving storage space during product development, however, is not usually a major concern in multiplatform development efforts.

There are major differences among the various SCM tools. These differences broadly affect the tools' ability to cope with cross-platform development. The key differences center around the following issues:

- whether the tool is file- or object-oriented
- whether the tool represents changes physically or logically
- whether the tool applies changes sequentially or selectively

For all but the most simple design efforts, a system that captures change as an object rather than as a file of source code is better. Source files lack the ability to represent all the things that need to be managed in a complex cross-platform development effort. They can only include the physical code itself and the various name tags (e.g., the name of the file and the name of the version to which the file belongs). Some of the things that cannot be easily represented include platform dependencies, code dependencies, and documentation dependencies.

A better candidate for a change "container" than a file would be an abstract data type called a *change set*. Such an object can be defined to incorporate all the features that are meaningful to the cross-platform development process.

A big advantage of using change sets is the ability to represent software changes as logical change rather than just physical change. A logical change is what the change accomplishes (e.g., converting output to PostScript format). A physical change is the physical evidence that results from the implementation of the logical change (e.g., changes to source files, executables, and documentation). SCM tools based on files are only suited to deal with physical changes, and primar-

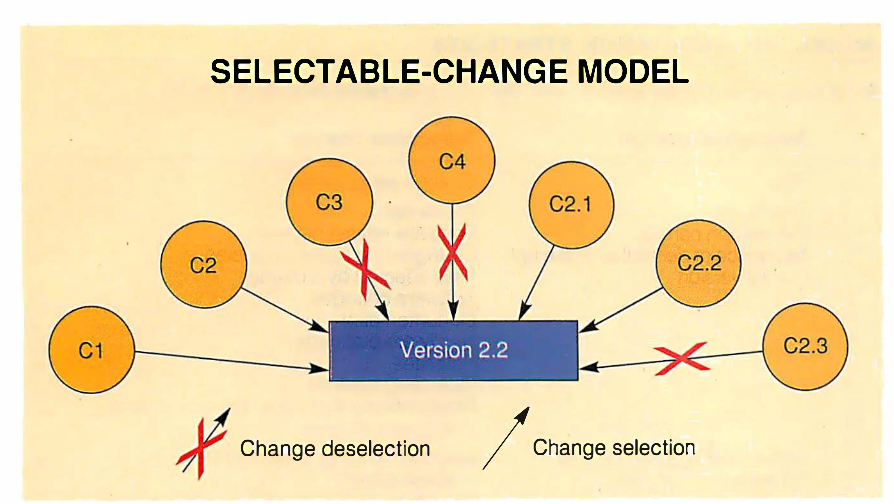


Figure 2: *The circles indicate changes. A version specifies a collection of selected changes. The diagram shows the change selections for V2.2 shown in figure 1 as though a single logical change were made between the versions.*

ily one kind of physical change at that: changes to the source code. A change object can just as easily capture changes to executable code, graphical data, imaging data, or documentation.

Change sets can also have features called *attribute tags*, which allow them to be manipulated on the basis of abstract criteria. As an example, the developer could ask the SCM system to list all change sets that support a specific function on a particular platform and that include references to specific subroutines. Fundamentally, the benefit of expressing change logically rather than physically is that it conforms to how people think. People are more likely to understand a change called "Convert output to PostScript format" than a change worded "version 3.2 of File 123, version 5.1 of File ABC, and version 3.7 of File XYZ."

The third criterion that differentiates SCM tools is the way they select software to be included in a version. There are two basic types of version-selection models: the sequential model (see figure 1) and the selectable-change model (see figure 2). In the sequential model, the SCM tool is, in essence, an archiving mechanism for recording the sequence of file versions as they are generated. The fundamental unit in the sequential model is the file version; changes are just bridges from one version to the next.

In the selectable-change model, the changes are the fundamental unit. A version is, in effect, a collection of changes. Systems that use the selectable-change model are always implemented in a way that permits individual changes to be included or excluded independently of each other.

The Sequential Model

SCM tools that are based on the sequential model are not really management systems; they are archival tools (i.e., they select previously named versions). A previously named version is one that was created by making changes to an older named version. SCM lets you pull together established versions from an inventory of source code files, not create new versions from the source code.

There are a number of variants of the sequential model. They share the following fundamental assumptions:

- The fundamental unit of specification is the version.
- Changes are represented as the differences between an old version and its successor.
- Each version (except the original base) has an immediate ancestral version.
- The only versions recorded in the system are those that are read into it; these are the only ones that can be retrieved from the system.

The simplest model is the linear sequential model. In this model, the system records a sequence of versions, each being the successor of the one immediately preceding it. Prior versions can be retrieved on demand, but only the latest version can be updated. The linear sequential model is fundamental; in most development efforts, it represents the normal sequence of events. Files are usually altered in a cumulative sequence of changes. SCM systems must be able to handle linear sequences of versions in a convenient manner. The fundamental

SCM-MODEL IMPLEMENTATION STRATEGIES

A comparison between the "manual" model of control-divergent sources and the two structured models for SCM.

	Manual	Sequential change	Selectable change
Elements managed	Files	Files	Change-set objects
Information available to developer	Filenames	Filenames File-version names Sequence of deltas that make up a file version	Filenames Software-release names Changes that make up a release Files affected by a change Software changes Documentation Hardware platforms Releases Operating systems Relationships and dependencies among software routines
Software development steps	Select an existing file version	Select existing versions of all needed	Select an existing release of the whole system Create a new release by selecting desired change sets
Product examples	None	SCCS RCS CMS	Aide-de-Camp

problem with the linear sequential model is that it does not provide a good method of dealing with parallel versions.

The branched sequential model is a natural generalization of the linear sequential model. From a given version, you can create branch versions, each with its own linear sequence of versions. The versions recorded in a branched sequential system form a tree of versions. All versions in the tree are retrievable, but only the version at the terminal nodes can be updated. Linear sequential and branched sequential models often use a simple version-numbering system for specifying versions. This is natural, because it corresponds to the sequences that are recorded. DEC's Code Management System is an example of a system that uses the branched sequential model for specifying names.

The basic problem with the branched sequential model is that branches, once established, diverge and are never reunited. This is not satisfactory. There are two major reasons for creating branches. The first is to create a parallel path of development that will later be merged into the main path. This is known as *version merging*. An example of this is when one development group works on a new release of a product while another group maintains the current release. At some point, the old bug fixes must be merged with new functionality.

The second reason for branching is to maintain parallel versions that have some specific difference (e.g., software that runs under two different operating systems). A bug fix often must be moved across all software releases of a product. This is known as *change migration*. In both cases, there must be communication between branches, which the branched sequential model does not inherently provide. There should be, for example, some way to know which changes made in one branch should be applied to another branch.

The Selectable-Change Model

The selectable-change model leads to true management tools rather than simple version-retrieval systems. The developer has the option of selecting new combinations of prior changes to produce previously unnamed versions. Given the additional capabilities of data-type abstraction provided by an object-oriented change definition, the selectable-change model enables true cross-platform software management. Developers can mix and match their source code to correspond to virtually any combination of hardware, software, documentation, marketing, or other criteria.

In this model, changes are created by comparing an old version of the file to an altered version. Each change receives a name. The changes are stored in such a way that each change set can be applied independently of the others. A version is specified by a list of changes to be applied. In principle, if there are N changes in the system, any of 2^N possible combinations of included and excluded changes may be a version. Versions can be defined at any time, but a version name is not automatically created for each change added. The changes are treated as independent, selectable units of change that are not tied to a particular version.

The major assumptions of the selectable-change model include the following:

- The fundamental unit of specification is the change.
- Versions are specified as collections of changes. This can be done implicitly or explicitly.
- In principle, a change need not represent the difference between two versions.
- Any combination of changes can be used to specify a version, even though the version so specified did not previously exist.

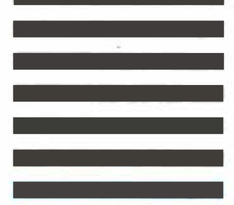
These assumptions are not always explicitly implemented in a particular system; however, they are implicit in the model. The only system with a full implementation of the selectable-change model is Aide-de-Camp from Software Maintenance and Development Systems. So-called update systems (e.g., IBM Update, CDC Update, and Historian Plus from Opcode) ordinarily lack a good method for referencing and representing versions. The modern implementation of the Source Code Control System (SCCS), generally packaged with Unix, is an interesting hybrid system; operationally, it behaves like a sequential-change model system, although its underlying technology uses the selectable-change model.

Model Implementations

The table describes the implementation strategies for tools employing the sequential-change and selectable-change models, along with specific product examples. For purposes of comparison, the

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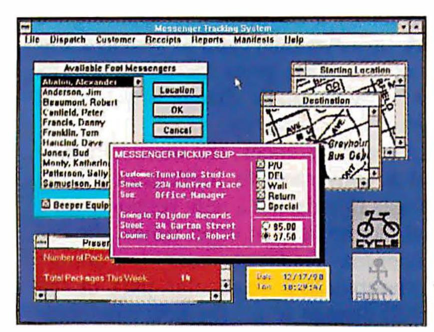


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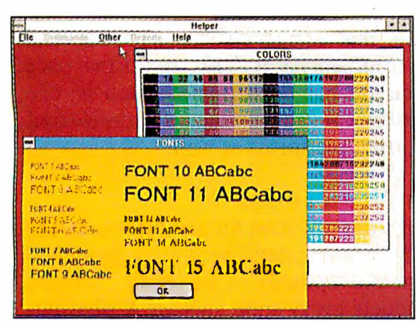
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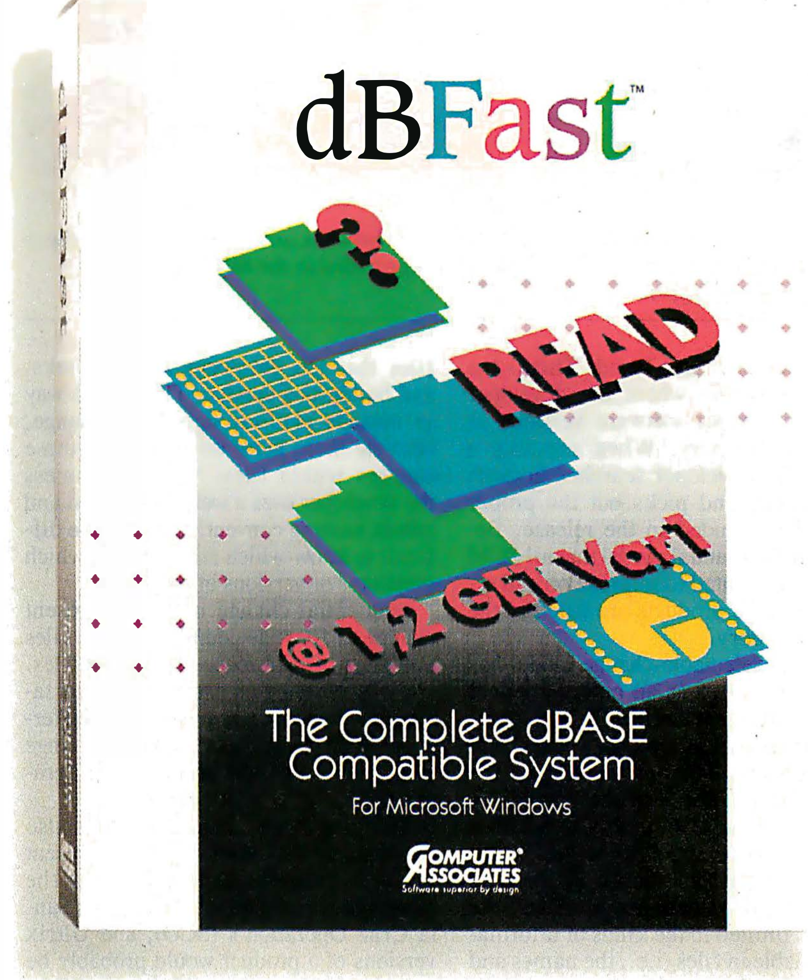
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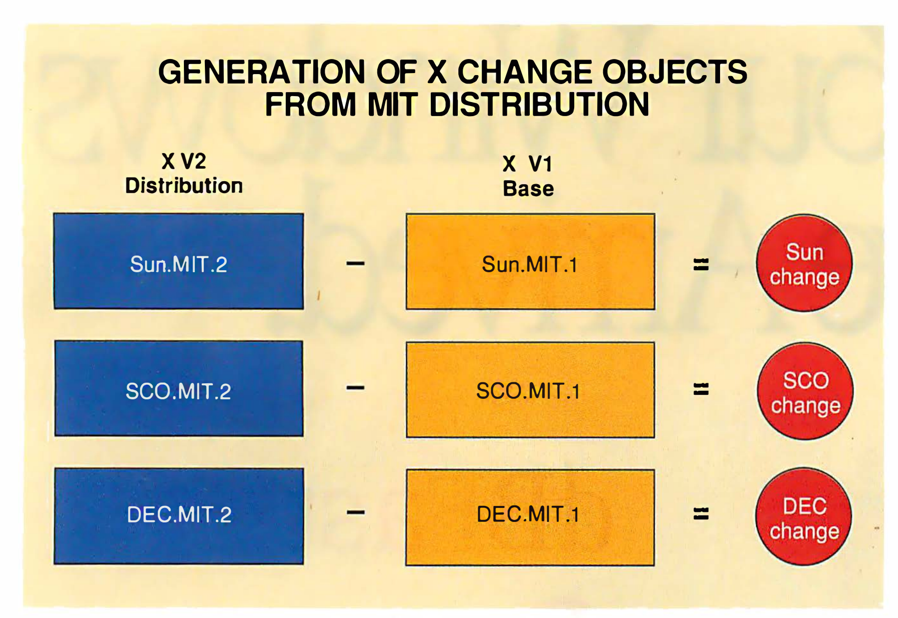


Figure 3: *A change set results from the difference between an existing version of the X files for each platform and the updated files provided in the MIT distribution version for that platform.*

manual model is also listed. This is the familiar scenario where the developer maintains various software versions as files in a directory. When selecting a version, the developer searches through the directory and picks out the proper files to be included in the release. Because it is the manual model that all SCM tools were invented to improve on and replace, no SCM products are listed in the manual category.

Only the selectable-change model has been implemented as an object-oriented system. This makes sense: Files impose a sequential way of looking at data, and objects do not. The next feature on the table is information available to the developer. This relates directly to whether change is represented in logical (i.e., abstract) or physical terms. If the data structures being managed are files, the system is limited to the kinds of information available in files (i.e., the names and contents of files). If the data structures are objects, a change can be associated with whatever information is meaningful to the developer.

Next, the table lists what the developer does to build a release. Only in the object-oriented, selectable-change model does the developer have the option of defining a release as something other than a previously named version. Finally, the table lists product examples.

How versions are built is a function of how versions and changes are represented. The manual approach represents a release as a number of complete program files that the developer selects, links, and builds as a version. There is no way to manage platform-dependent change, because there is no way to isolate these changes within files. Moreover, unless the developer uses a well-disciplined and robust naming convention, it may be difficult to know which files go with which platforms or versions of platforms.

Sequential-change models represent change as files: as complete source files and files of differences to source files. Only by creating an external naming table can developers equate these differences with meaningful units of change (e.g., new functions or platform migrations).

Defining change in terms of files also encourages the developer to represent multiple program versions within the same file. For example, Mips', The Santa Cruz Operation's (SCO), and Ultrix versions of a product would probably be contained in the same file on an SCCS system. To express the appropriate code on the appropriate platform, the developer will probably insert conditional statements in the code.

The purpose of these conditional statements is to check to see on which platform the program will run and to "turn on" the parts of the program relevant to that platform. In essence, the developer implements a code management scheme in the source code. This approach also results in the developer always seeing all existing code variants every time a file is viewed, irrespective of the one version currently of interest.

The object-oriented approach also uses the idea of deltas, except that in this case the deltas are not the objects that are being manipulated by the developer. Deltas, or collections of source code changes to a given file, are defined as features of a change set. Unlike deltas, change sets can include features other than source code (e.g., the author and date of the change, relevant documentation, software relationships and dependencies, and hardware relationships). These features can be used to collect and apply changes that are relevant only to specific platforms or other operating conditions.

In contrast to deltas, change sets are not necessarily defined as the difference between two successive versions. Several change sets, or a single change set, can represent all changes that result in a new version. Several changes can also be tied together by a common attribute (e.g., a work-order number) and treated as a single object. This gives the developer the flexibility to handle change with varying degrees of granularity.

In some instances, the developer may find it convenient to implement all the changes that define a new version with a single identifier. At other times, the developer may find it necessary to examine or manipulate a particular part of the overall change (e.g., the new password-retry restriction). Not only can change objects that implement part or all of a named version be defined, but change objects that implement entirely new versions can also be defined, including versions that merge changes from several development paths. This means that once a feature has been implemented on one platform, it can be selected or deselected for other platforms as well.

An Object Lesson

A good application for an object-oriented SCM system would be if a company had to make updates to its many X-based products every time another X distribution arrived from MIT. Every two or three months, MIT sends out a distribution disk containing a complete directory for each X platform MIT supports. The directory includes a list of bugs fixed or changes made since the last distribution, but with no reference to files changed. A software company receiving the distribution must integrate the changes into its own software releases for the various platforms it supports.

In an object-oriented SCM environment, the company would do this by comparing source files, identifying deltas, and defining change sets containing



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these deltas. As shown in figure 3, a change set results from the difference between an existing version of X files for each platform and the updated files provided in the MIT distribution for that platform. Although figure 3 shows the difference for each platform as a single change set, in practice there would probably be many change sets, depending on the number of logical changes contained in the distribution for each platform. Each change set is also assigned appropriate attributes (e.g., version number, platform, and feature name).

The sum of all the change sets for all platforms could also be represented as a single change object. This collection of change sets, representing the new X features, can then be migrated to the company's various platforms.

As shown in figure 4, a new version of the software company's products (i.e., ones with the new X features) results from the application of the change sets to the existing version of each of the company's products. For some platforms, no doubt, not only would the new change set have to be selected for a particular platform, but some prior changes, such as those from a previous X distribution, would also have to be deselected.

Because the new code on the X distribution disk comes from outside the path of the company's own sequence of development, it cannot manage these changes using a sequentially oriented SCM system. The only alternatives are to hand-stitch (and later perhaps unstitch) the X code into its product—or else use objects to turn these changes on and off.

continued

APPLICATION OF X CHANGE SETS
TO EXISTING PLATFORM-SPECIFIC PRODUCTS

DEC change
Sun change
SCO change
DEC V1 (with old windows)
Earlier changes
Sun V1 (with old windows)
SCO V1 (with old windows)
DEC V2
Sun V2
SCO V2
Change deselection
Change selection

Figure 4: *A new version of the products built using X features results from the application of the change sets to the existing version of each of the products.*

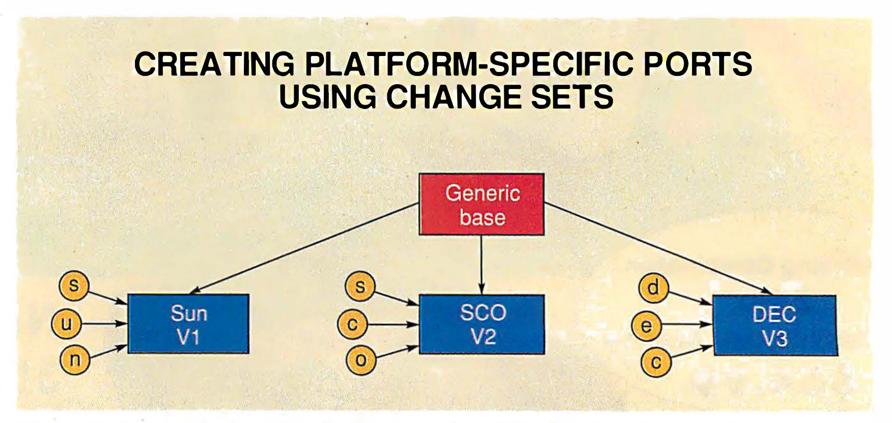
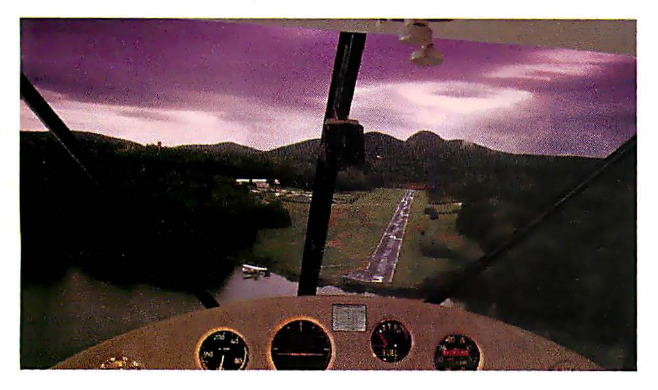


Figure 5: *A simplified model of a product port of generic files to Sun, SCO, and DEC platforms.*

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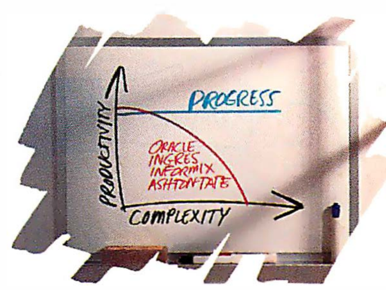




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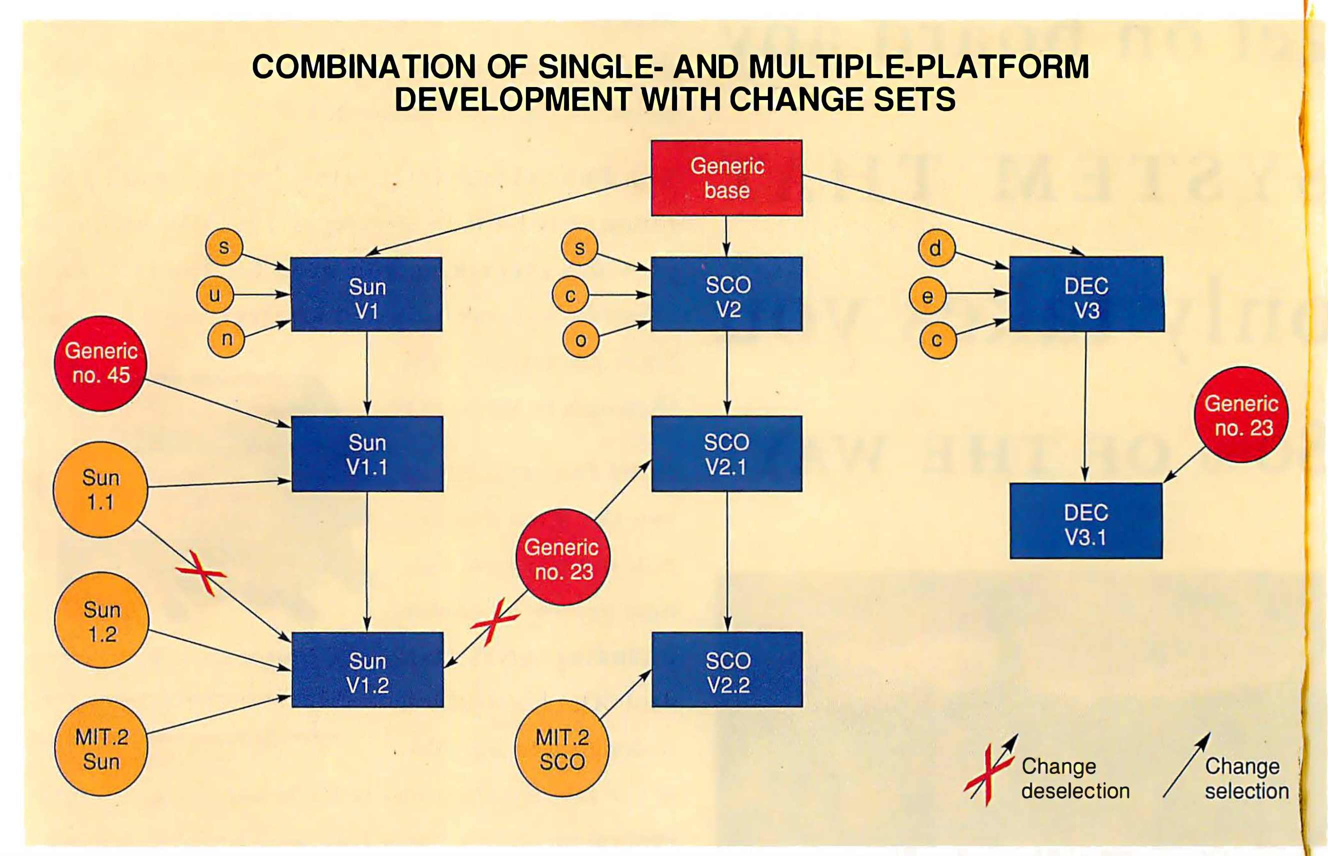


Figure 6: *Simultaneously developing software in two directions means that changes are made to successive versions of a product on each platform, and changes made to a product on one platform are migrated to products on other platforms.*

The benefits of an object-oriented approach become even clearer in the X-update example when one remembers that the X-related changes are not the only kinds of changes likely to be happening to the product at any one time. Among the other types of changes that are also occurring simultaneously are ports to other platforms, as well as general product-feature innovations.

Figure 5 shows a simplified model of a product port of generic files to Sun, SCO, and DEC platforms. For purposes of illustration, the changes needed to turn the generic base into a platform-specific release are represented as just a few change objects for each specific platform.

Again, there might very well be many change sets associated with each logical change required for a platform migration; however, all change sets could be linked to one object—and the number of change objects involved does not alter the basic methodology. For this company, changes have been organized into change objects so that a port is implemented by selecting the change set associated with the desired platform and deselecting any other port's platform-specific changes that may have been present in the code.

Figure 6 illustrates the process of developing software in two directions at once. Changes are made to successive versions of a product on each platform, and changes made to a product on one platform are migrated to products on other platforms. Again, to keep the picture simple, only a few change objects and a few releases are shown. Whether porting the product to other platforms, developing successive versions on the same platform, or importing external code, as with the previously mentioned case with X, changes are managed in a consistent and coherent way. Where software originates—or is used—does not restrict the management process.

The ability to move changes between development paths does introduce one complication not encountered in sequential-change SCM systems—conflict. A conflict might be created when a change on one development path removes a subroutine and a change on another path includes the subroutine. If the two changes are merged into the same path, someone must review the changes to see that the conflict is resolved.

Conflict can occur any time two development paths change the same file. For example, if `file.list.mit` is the list of files changed between MIT V1 and MIT V2, and `file.list.local` is the list of files changed between local version V1 and local version V2, then the intersection of these lists consists of files to be checked for conflict. Even though no system has been invented that resolves logical conflicts automatically, an object-oriented system is ideal for identifying situations where such logical conflicts can exist. That is because it can sort changes by attribute (e.g., all the changes made to a release that reference the same subroutine or hardware device).

Complexity issues such as conflict are more likely to occur in the multiplatform environment, where most software writers work today. These are the kinds of issues that computer technology, especially object-oriented technology, is particularly well suited to address. It is ironic that software developers have waited so long before applying these techniques to their own work. ■

Randall D. Cronk is a Boston-based freelance writer on computer technology and the industry. You can reach him on BIX c/o "editors."

LET THE SYSTEM DO THE PORTING

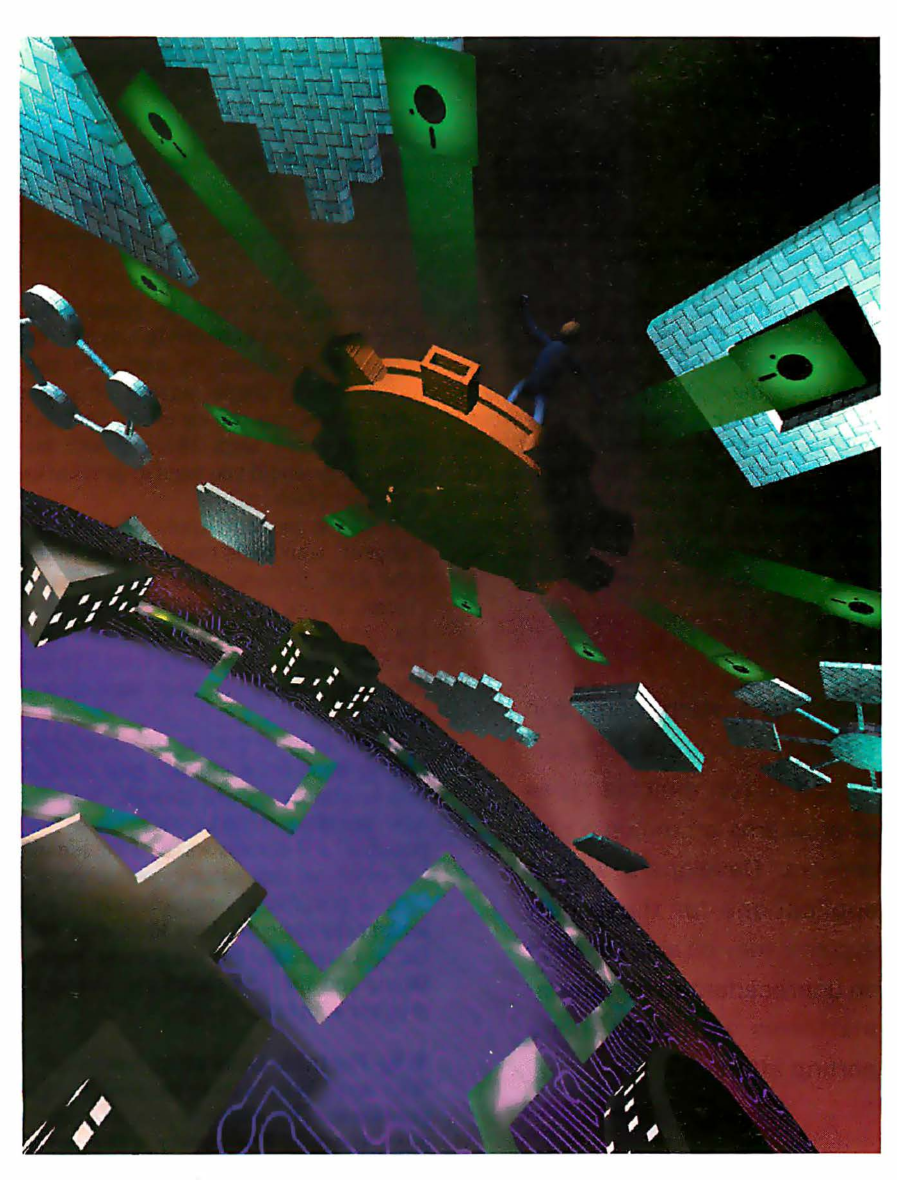
New cross-platform operating systems are coming in the 1990s

ELLEN ULLMAN

The operating system used to be the last place you would look for help in writing applications for multiple platforms. Traditional system software looked down deep into the iron. The operating system was part of the hardware—designed to complement it, fix its limitations, and highlight its good features. The system software was like an iceberg: One-tenth of it was visible above the surface, and nine-tenths had a secret existence deep below.

Suddenly, the operating system is cutting off its longtime relationship with hardware. Microsoft, SunSoft, the Apple/IBM alliance, The Santa Cruz Operation (SCO), and other vendors of system software are falling over each other to offer portable operating systems (see the table). All these companies are promising to deliver systems in the first part of the 1990s that will run on multiple processors using both CISC and RISC architectures.

A number of these new systems will offer full binary compatibility across microprocessors and some source code compatibility. Some will run programs designed for other application programming interfaces (APIs). But whatever the degree of portability, the new operating systems will free the developer from dependence on a single type of hardware. The idea of the portable operating system, which began with Unix, now seems to be everywhere.



Vested Is as Vested Does

Will the new portable operating systems solve the problem of cross-platform development? Not completely. System vendors aren't going to make it easy to port

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NEXT-GENERATION PORTABLE OPERATING SYSTEMS

Operating systems that have been announced for the first part of the 1990s include four brands of Unix, one of Windows, and one altogether new breed of object-oriented system. The ideal of the portable, scalable operating system—which started with Unix—will live on into the next decade.

Operating system	Company	Description	Platforms	Supported APIs	Release
Open Desktop	The Santa Cruz Operation	OSF/1-based Unix with X/Motif user interface; ACE operating system	Mips R3000; Mips R4000; Intel 80x86	OSF/1 Unix; Posix; DEC Ultrix; SCO Unix System v/386; SVR4 kernel	Mid-1991 for Mips R3000/R4000 (Open Desktop for Intel shipped January 1990)
PowerOpen	Apple and IBM	IBM AIX with Apple and OSF/Motif user interfaces	PowerPC RISC* on machines from Apple and IBM	AIX; Mac	1993-1994
Solaris 2.0	SunSoft (Sun Microsystems)	SVR4 Unix with Open Look user interface	SPARC; Intel 80x86	SVR4 Unix; on Intel platform only: DOS (emulation), Windows 3.0 (emulation)	First half 1992
Taligent	Taligent (Apple and IBM)	Platform-independent; object-oriented	PowerPC RISC*; Intel 80x86; Motorola 680x0	Mac; OS/2; AIX	Mid-1990s
Windows NT	Microsoft	32-bit, multitasking Windows; ACE operating system	Mips R4000; Intel 80x86	32-bit Windows; 16-bit Windows (emulation); DOS (emulation); Posix; OS/2 1.3 and 2.0	1992
USL SVR4 (ACE version)	Unix Systems Laboratories	The original portable operating system	Mips R3000; Mips R4000; Intel 80x86	Posix; SVR4; OSF/1 AES	Second half 1992

* single-chip version of RS/6000

applications between their own platforms and those of their competitors. Until clear leaders begin to emerge from the new operating-system pack, vendors will continue to have a vested interest in touting the competitive advantages of their own systems. The code for Windows NT is not likely to translate into SCO Desktop code, and Solaris applications probably will not easily migrate to the Taligent object-oriented system.

BYTE ACTION SUMMARY

Operating systems coming in the early 1990s are being designed to run multiple types of programs on multiple processors. Developers writing applications for these new systems may be able to reach an unprecedented number of platforms with little or no porting effort.

However, new portable systems will offer developers a chance to reach an unprecedented number of hardware platforms with a single version of source code. If you can run on every Sparcstation and every Intel 386 and 486 machine, why would you need to develop for any other platform?

With the nascent Apple/IBM system, Taligent, your code could run on Macs, IBM RISC System/6000s, and Intel machines. If you choose SCO Open Desktop, your code will run on every Mips R4000 machine and every Intel 386 and 486. Why would you ever want to port again?

Never have to port again? Just being able to hope for a utopian goal such as this is almost reward enough. Will the new portable systems make that goal possible? I'll discuss some of the technical advances that made possible the advent of portable system software. I will look at the systems about to emerge over the next decade, the companies behind them, and the cross-platform strategies they are adopting.

Why Portable Operating Systems?

Why now? Why is there the sudden competition to offer multiple-processor operating systems? The answer is that portable operating systems had to wait for two long-term developments. First came the need for more powerful desktop microprocessors. Then came the need for the desktop market to agree on the proper role of the personal computer's operating system.

Consider the evolution of the desktop microprocessor. Advances in chip design and integration have given us CISC and RISC chips with processing power unimaginable in the days when CP/M and MS-DOS were born. Add to that factor the advent of cheaper memory and faster I/O channels, and suddenly desktop systems can supply more cycles than you can possibly use when you are running a single program.

Existing operating systems were created during a period of scarce system resources. At that time, traditional system software was based on the idea of limitations—in processor cycles, memory, and I/O channels. Developers of operating systems had to devise a way to dole out resources to hungry programs—the third-world model of needy processes and not enough goods to go around.

Scarcity—The Mother of Invention

During the bad old days of "legacy systems," what differentiated one operating

system from another was its approach to the condition of scarcity. Memory was chopped up into regions or segments, fixed or variable, real or virtual. Processor cycles were scheduled by time slicing and round-robins and so on.

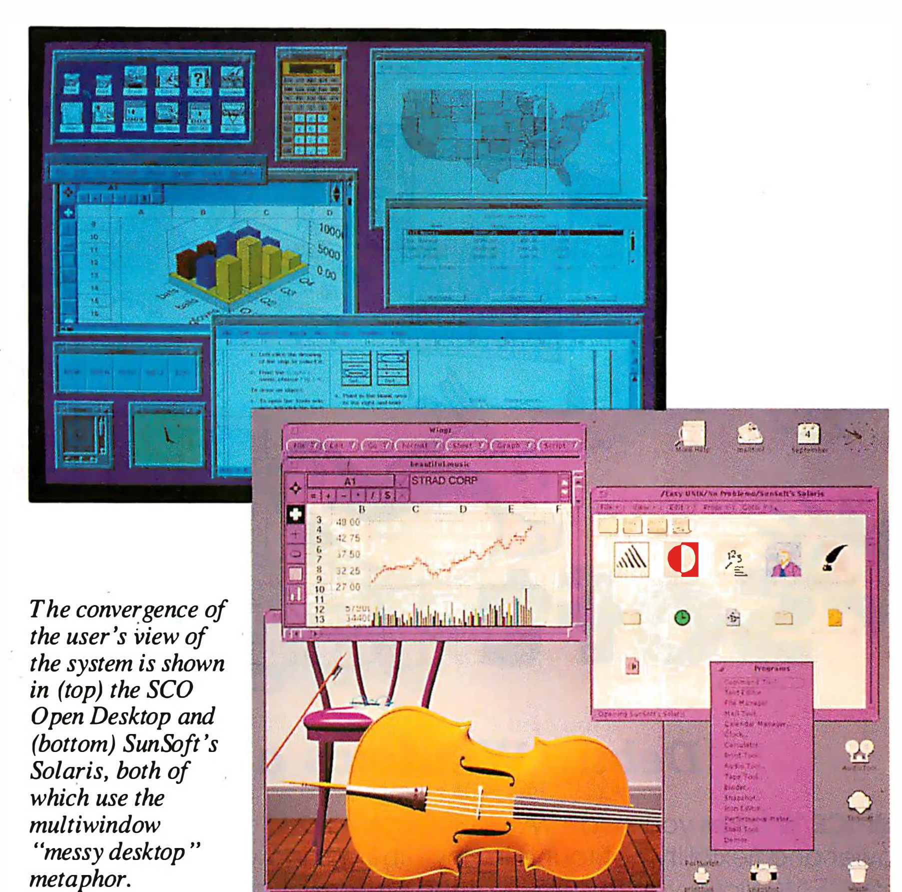
Some systems could handle only one task at a time; some, only a fixed number of tasks; some, a variable number. And applications were not shielded from the particularities of these internal designs. The API was little more than a set of calls that directly reflected the architecture of the underlying operating system.

At that time, a traditional system took its name and flavor from the set of design solutions chosen by its developers. MVS (Multiple Virtual System), VM (Virtual Machine), and VMS (Virtual Memory System) are but a few of the classical operating systems that were named for the type of architecture they used. To see how things have changed, consider the names of forthcoming systems—Open Desktop, Windows, Taligent, and Solaris. None of these monikers even attempts to describe an operating-system design solution, except perhaps to hint at the heady and slightly misleading idea of openness.

Then prevalent resource rationing applied to the operating system as well as to the applications it had to support. Kept busy loading programs, allocating memory, keeping track of registers, and so forth, the operating system had little time left over for extra services. Operating systems and hardware had to work in concert as tightly tuned and tightly related mechanisms.

As hardware became more powerful, the operating system began to offer more services to support applications. Like any other program, system software can take on more than basic housekeeping tasks. User input support, graphics display, interapplication communication, even object linking—all these services are now seen as essential operating-system work.

Now, sitting atop powerful processors, the modern operating system not only can offer more services, it can also afford to abstract those services: The system can present memory, devices, and user inputs as metaphors, not machines. With many more processor cycles available, the system can absorb the overhead of abstraction without significantly degrading its performance. In other words, the operating system can begin to present itself as a truly virtual machine. It can interact with the hardware below the surface, all the while offering an entirely different face to the application program.



The convergence of the user's view of the system is shown in (top) the SCO Open Desktop and (bottom) SunSoft's Solaris, both of which use the multiwindow "messy desktop" metaphor.

The more powerful the hardware, the less the application has to be aware of it. The operating system, freed from squeezing every last drop of performance from the hardware, can pay more attention to the application. The API is no longer a by-product of system design; it is the reason for the system design. It's as if the iceberg has flipped over: The operating system has begun to spend less time looking down and more time looking up at its client programs.

Agreement on the Role of the Operating System

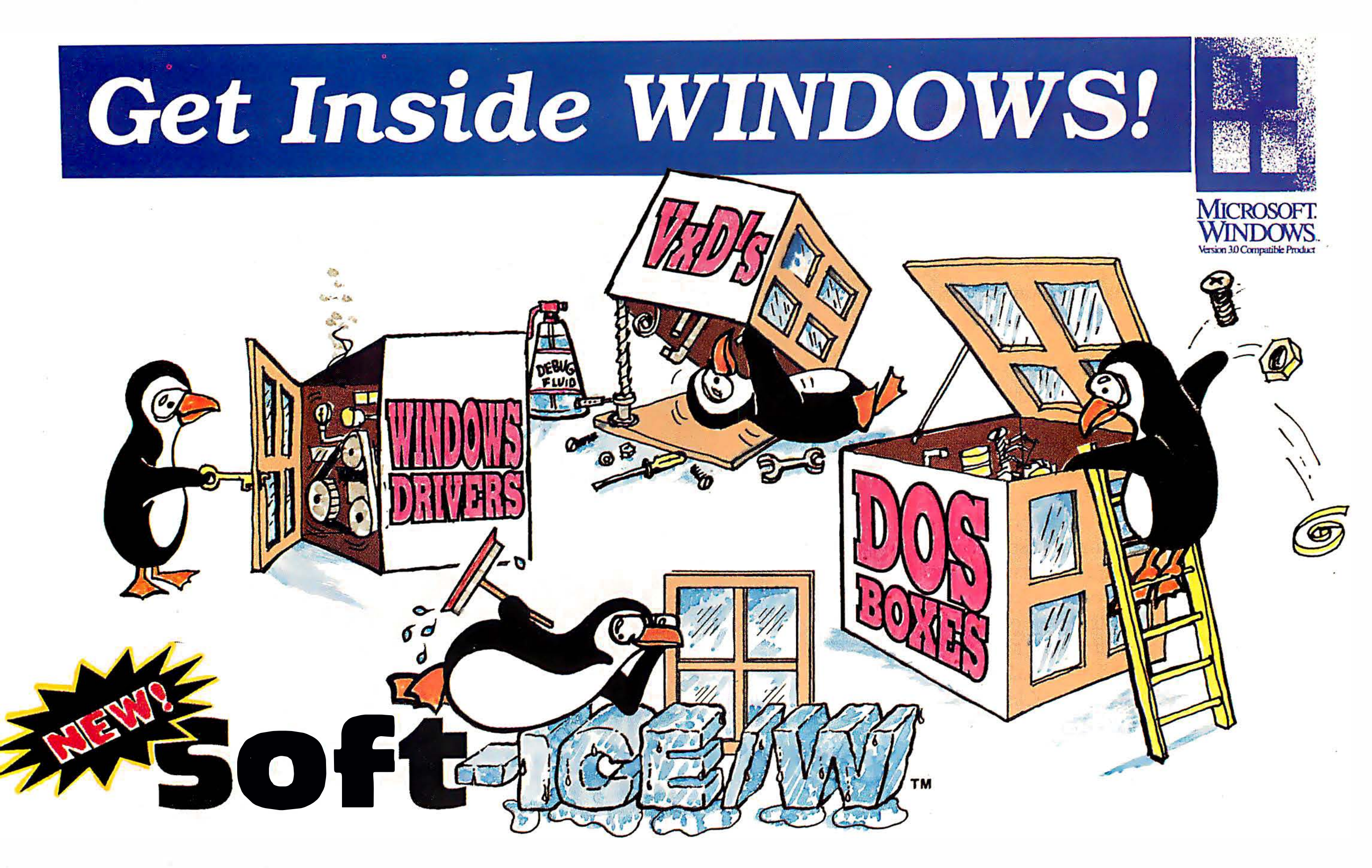
We hear little argument among vendors these days about what an operating system should be—their lists sound almost interchangeable. Just about all system vendors, it seems, will support multitasking, symmetric multiprocessing, 32-bit addressing (at least), a flat memory model, and virtual memory. Every system will have a GUI, and there will be support for networking and distributed processing. Systems will be event driven and will have interprocedure communications mechanisms and some form of object-linking scheme.

Even the look and feel of the new operating systems is beginning to converge. All the new systems present themselves to the user as desktops filled with icons and palettes. Point and click, copy and paste, drop and drag—by now almost everyone knows how to perform these operations.

Generally speaking, this convergence in operating-system features (see the screen) helps users, operating-system designers, and applications developers. Users can carry their experience from one system to another, no longer confronted with that terrible blank screen waiting for input. Operating-system designers, freed from having to reinvent the wheel, can concentrate on applications services and portability strategies. And developers inherit the extra work being performed by the operating system.

Notice that this agreement about operating systems is only occurring on mature platforms. Don't look for portable operating systems yet on palmtops, handheld computers, and pen-based systems. In those arenas, hardware standards are still emerging, and resource scarcity—especially scarcity of power—is still a major factor in system design. For now, where machines are portable, system software is not.

continued



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ACE Initiative: Deuce or Joker?

In April 1991, 21 companies affiliated and announced the formation of the Advanced Computing Environment (ACE) initiative. At the onset of this liaison, the computing world was overwhelmed with the idea of unprecedented software portability across two processors and two operating systems, available from multiple hardware and software vendors. Then reality set in.

Once there was time to look more closely at what ACE was offering, it was clear there would be no magic portability pill. The group had chosen to standardize on two operating systems, a Unix system called Open Desktop, from SCO, and a new version of Windows from Microsoft, to be called Windows NT (for New Technology).

Each of these systems would run on two architectures, the Mips R4000 RISC chip and the Intel 386/486. However, although each system would be portable across hardware platforms, ACE would not even address the question of a porting strategy between the two operating systems. In other words, the two operating systems would be competitors, not portability partners.

To further complicate the picture, a dissident group within the initiative was protesting the choice of SCO's OSF/1-based version of Unix. The self-proclaimed Apache Group within ACE was fighting for a System V release 4.0 (SVR4) version of the Unix operating system in place of, or along with, the SCO system.

As of this writing, ACE has agreed to add support for the SVR4 kernel, and Unix Systems Laboratories has joined the ACE group. This ACE support for SVR4 may mean the first step toward a merged Unix API, or it may mean more intense competition within ACE over the future of Unix. USL intends to supply its own "ACE-compliant" operating system, placing itself toe-to-toe with SCO.

ACE, as it turned out, was really a deuce. The group of 21 had chosen two of everything: two "standard" operating systems, two competing versions of Unix, two microprocessors, and, as was later announced, two standard hardware buses. There would be not one applications binary interface, but two—one for RISC architectures and one for CISC architectures. The initiative would not deliver on the tantalizing promise of shrink-wrapped applications able to run on all "ACE-compliant" hardware. According to Richard Treadway, manager of the Western Software Laboratory at DEC and an ACE participant, there might be "incompatibilities" between the hardware platforms, even within operating systems.

Reviewing the ACE portability road map, it was soon clear that developers wishing to write applications for all ACE-compliant hardware would need four compilers and two architecturally incompatible versions of source code. They would need source code for Windows NT and for SCO Desktop, as well as compilers for Windows NT on Intel, Windows NT on Mips, SCO Desktop on Intel, and SCO Desktop on Mips. This is portability? Is ACE a joker?

To be fair to ACE, the portability benefits of the initiative should be looked at one operating system at a time. A certain amount of cynicism is unavoidable when you look only at the hoopla of the overall announcement involving multiple processors, software vendors, and hardware manufacturers.

But, putting aside the political complications, you can see that ACE is offering developers competition in the very area that will benefit them: cross-platform operating systems. Two very different operating systems, SCO and Windows, are competing for precedence across the CISC/RISC divide. This competition can only be good for developers.

What follows is a roundup of the new cross-platform operating systems due in the first part of the 1990s, starting with the two ACE offerings.

SCO Open Desktop

SCO's version of Unix for the Intel 386/486 platform quickly became a popular system environment. As an example of the burgeoning success of SCO Unix, a recent survey of the members of UniForum, a Unix users organization, reported remarkable growth in the use of the SCO system. Between 1990 and 1991, use of SCO Unix went from somewhere in the "other" category to second in overall use among UniForum members, ahead of SunOS and second only to Unix System V.

SCO no doubt hopes to find the same response to its version of Unix for the Mips R4000 platform. SCO Open Desktop for Mips will allow developers who have switched to SCO Unix to follow their operating system to the RISC platform. Open Desktop for Mips will offer source code compatibility with Open Desktop for Intel-based applications and with applications written for SCO/Unix System V/386. In addition, SCO Desktop offers binary compatibility with DEC Ultrix systems.

SCO describes the Open Desktop as consisting of three components: operating-system services, networking services, and the GUI. According to reports

from SCO, the kernel of the Open Desktop is based on OSF/1 technology.

The system incorporates technology from USL's System V/386 release 3.2. The operating system is compatible with multiple standards for the Unix system, including the following: X/Open Portability Guide Issue 3, Posix 1003.1; Posix 1003.2; Posix 1003.4 (draft); FIPS 151-1, OSF Application Environment Specification; System V Interface Definition Issue 2; and System V Interface Definition Issue 3.

The networking component, like the core operating system, will support multiple standards. The SCO system will support TCP/IP, Sun's Open Network Computing (ONC), Microsoft's LAN

Windows NT is a 32-bit operating system that uses a flat-memory model.

Manager for Unix Systems Client Support, Simple Network Management Protocol Agent support for network administration, and, as specifications are finalized, Open Software Foundation's Distributed Computing Environment.

The SCO Open Desktop graphical interface uses the OSF/Motif window manager and is based on the X Window System 11 release 4 standard. When you start up the system, you see a desktop showing icons of available programs and services. You can use drop-and-drag operations to execute interactions among applications. For example, you can drag text from a word processor to an E-mail program to send a memo.

The desktop will also include some form of encapsulation of programs and data, a feature known as *object linking*. At the first demonstration of the system, given last October at a Mips event in San Francisco, SCO announced that opening a file could start up the application that had created the file (e.g., opening a text file could start the word processor).

This encapsulation feature hasn't been demonstrated as of this writing, nor has SCO literature described the mechanism. However, given the competition with

Microsoft, which has made much of Object Linking and Embedding in its Windows product for Intel, program/data encapsulation is sure to be a must-have feature for SCO.

Windows NT

Windows NT has its history in the tortured relationship between Microsoft and IBM. The two companies jointly began working on a new graphical 32-bit operating system to replace DOS on Intel platforms. That new operating system was supposed to be OS/2 2.0 with Presentation Manager. Then something happened. According to Microsoft, its Windows 3.0 sold about 2.75 million copies in its first seven months on the market.

Microsoft, finding its fortune in the Windows platform, began parting ways with IBM. After months of rumors and confusion, the two companies announced their separate plans. IBM would work on OS/2 2.0, and Microsoft would take on OS/2 3.0. In a short time, though, Microsoft abandoned all pretense of working on any operating system called OS/2. The company began referring to its new system software as *portable Windows*, then as *Windows New Technology*. With the announcements of the ACE initiative and the Mips R4000, the issue was settled once and for all: Microsoft's new operating system would be Windows New Technology, or NT.

Windows NT is a grown-up form of the popular Windows 3.0 environment. The familiar graphical interface is there, but the system is no longer just a pretty task switcher for DOS. Windows NT is a 32-bit operating system with support for preemptive multitasking, multithreading, and symmetric multiprocessing. It uses a flat-memory model with a protected paged-memory design. The specifications include certified security and support for the 16-bit Unicode character set, which will enable the system to support non-Roman alphabets.

But the design of Windows NT had to be more than that of an advanced operating system with a graphical interface. To save its investment in its current user base, Microsoft had to build into NT an upward migration path from the current Windows 3.0 and DOS platforms. The company approached the problem by turning to a microkernel approach, a technology used in the Mach operating system developed at Carnegie Mellon University. A layered system—consisting of a microkernel, privileged processes, protected subsystems, and applications—lets the operating system run on multiple processors and support multiple APIs.

Windows NT concentrates the core of its system services in a microkernel, or the NT Executive, as Microsoft calls it. This kernel, which consists of 50 KB of compiled code, contains the machine-dependent portion of the operating system, including support for thread dispatching and multiprocessor synchronization. The kernel is rewritten for different processors. It serves as the native portion of the system, isolating machine dependencies from other more machine-independent operating-system services.

Above the NT Executive layer are the privileged-mode extensions—processes such as device drivers, file systems, and LANs, which have direct access to hardware resources and file-system services. For example, Microsoft is implementing LAN Manager, its PC LAN software, as a privileged process.

The protected-subsystems layer is the component that makes NT capable of supporting multiple APIs. Protected subsystems run as separate "fire-walled" tasks (i.e., they cannot cause one another to crash), each supporting a different API.

Microsoft plans to provide three subsystems: Windows, OS/2, and Posix. The Windows subsystem will support 32-bit Windows programs, 16-bit Windows programs (via emulation), and DOS programs (also via emulation). The OS/2 subsystem will run OS/2 1.3 and 2.0 programs. The Posix subsystem will run programs adhering to the Unix standard 1003.1. Because subsystems are implemented as separate tasks and NT is a multitasking operating system, the three protected subsystems can run simultaneously. For the user, this means Windows NT can run multiple types of programs (e.g., Windows, DOS, Posix, and OS/2) at the same time.

The outermost layer of the NT system is the application. Applications are seen as clients of the protected subsystems. Clients issue requests for system services, which are passed to the appropriate subsystem for handling. In this sense, NT uses a remote-procedure-call model between the client application and the server subsystem.

The final shape of Windows NT is not yet clear. The system will run all those applications, but how much interaction will be permitted among them? Will you be able to cut and paste or drop and drag between Posix and Windows programs or between OS/2 and Windows? And what about networking support? NT has provided the structure for networking (in the privileged-mode extensions layer), but company literature describes the extensions as "a very general architecture" that "can be used by vendors of other networking services." It appears that network implementations will provide the

proverbial third-party opportunities, and may therefore come sometime later than the operating system itself.

SunSoft Solaris

Sun Microsystems has been nearly synonymous with SPARC. The company designed the SPARC RISC architecture and led the efforts to manufacture and license the standard. Then, in February 1991, Sun announced it would become the parent company for three subsidiaries, each one chartered to succeed on its own. SunSoft, the new system-software subsidiary, must have looked with great longing at the enormous installed base of Intel machines. In September 1991, the company announced Solaris (see the figure), a Unix operating environment that would run on both Intel 80x86 and SPARC platforms.

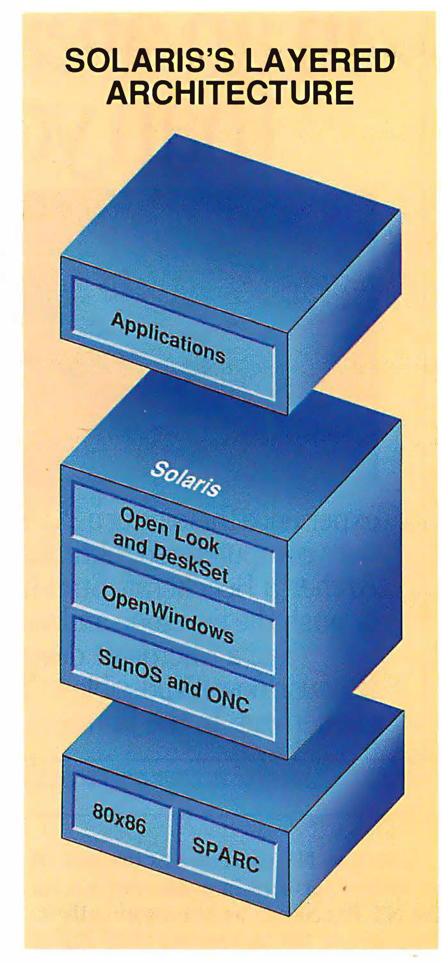
Solaris 2.0, due out in the first half of 1992, will be the cross-platform version of the Solaris 1.0 operating system currently available for SPARC. The entire operating environment will be portable, from developer tools to operating system to user interface to desktop accessories. Solaris 2.0 will offer the developer the advantage of a completely symmetrical development environment across CISC and RISC architectures. The source code is carried to the other platform, and, using the same tools as were used on the original platform, the program is recompiled.

Solaris is based on SunOS 5.0, an SVR4 version of Unix. The system has support for multitasking, multithreading, and symmetric multitasking. Like most Unix systems, Solaris provides extensive networking support, including ONC and the beginnings of Project DOE (for Distributed Objects Everywhere), a network-transparent object-messaging facility under joint development with Hewlett-Packard.

The Solaris user interface will employ a new version of the Open Look X Window manager. You will be able to perform drop-and-drag and cut-and-paste operations among applications running anywhere on the network. And, unlike other Unix systems, Solaris is prepared to run "foreign" programs: Solaris 2.0 on the Intel platform will provide DOS and Windows emulation, and you will be able to cut and paste between DOS/Windows applications and Unix programs.

Apple/IBM PowerOpen

In 1991, just before the Fourth of July, Apple and IBM stunned the computer industry with the announcement of a technology partnership. Among the several facets of this momentous agreement was a relatively prosaic element: a partnership on a new joint version of the Unix operating system, later dubbed the PowerOpen system.



The layered architecture of Solaris 2.0 from SunSoft. Microsoft also describes its Windows NT system as "layered."

The PowerOpen system, due in 1993 or 1994, will combine IBM's AIX version of Unix with Apple's Macintosh user interface. In addition, the system will support the OSF/Motif user interface; you will be able to choose between the GUIs.

PowerOpen will run existing applications for both the Mac and AIX, giving you access to applications that previously required a distinct architectural choice. The combined Apple/IBM system will be Unix with a friendly face, and it will offer access to all those friendly Mac applications. As described by Apple president Michael Spindler, PowerOpen is designed to be a "Unix for the many."

PowerOpen will run on the new PowerPC RISC processor, a single-chip version of IBM's RISC System/6000 chip set, which both Apple and IBM will use in their machines. Designed for one processor, PowerOpen is therefore not technically a cross-platform operating system, as are the others discussed here.

Although PowerOpen will run on only one processor, it will provide the first unified development path that crosses the previously trackless Apple/IBM divide. The system will represent the first joint effort of two companies whose differences have been nearly religious in character. It is in the ecumenical spirit of PowerOpen that I characterize it as a cross-platform system.

Apple/IBM Taligent

The most ambitious piece of the new partnership between Apple and IBM is their joint venture to build a new object-oriented operating system. This operating-system venture is also the most uncertain part of the agreement. Not due until the mid-1990s, the new operating system is still mostly promise and promotion.

What is really known about this most ballyhooed of ventures? Apple and IBM will form a new 350-employee company called Taligent. Taligent will build a "platform-independent" object-oriented operating system. The system will be designed as a cross-platform operating system, running multiple types of programs on multiple processors. As it is now described, Taligent will run Mac, OS/2, and AIX applications on PowerPC RISC, Intel 80x86, and Motorola 680x0 processors.

However, little is known about the details of the Taligent system, and even less about how the two companies will solve their technical and business differences. The final shape of Windows NT is not yet clear. It will be difficult, if not impossible, for Apple and IBM, opposites in corporate culture, to learn to work together. Industry representatives wonder how Taligent will merge the technical contributions of these two competitors.

Taligent had its origins in what appeared to be just one more unpromising IBM technology partnership. The answers to the questions concerning this new effort may lie in the history of the joint venture.

In September 1990, IBM announced the formation of Patriot Partners with Metaphor Computer Systems, a Mountain View, California, software company. Patriot was to build a cross-platform software development environment. At that time, IBM already had two unsuccessful partnerships under its belt. The company had licensed NextStep but

had done nothing with it, and the relationship with Microsoft on PC operating systems had already gone sour. No one expected the alliance with Metaphor to be any different.

Yet Patriot Partners went on to become one part of Taligent. Shortly after the announcement of the Apple/IBM alliance, IBM acquired Metaphor, and with it the work done by Patriot. Patriot, renamed Constellation to avoid association with the now-famous Patriot missile system, would become IBM's contribution to the Apple/IBM joint operating-system venture. Apple would contribute its nascent object-oriented operating system, code-named Pink.

Looking at the two technical contributions to Taligent—Constellation and Pink—you can predict a few things about the new operating system to be offered by Taligent. Although there is no assurance that Taligent will represent a blending of these two technologies, Pink and Constellation should provide clues about the directions Apple and IBM consider important.

Constellation was designed to be a component-software platform. Using the metaphor of machine tools, the component-software model sees applications as assemblies of replaceable parts. Just as the pieces of one machine can be taken and reused in another machine, component software is made up of individually made parts that can potentially be recombined to build a new application.

Developers would write small, highly focused programs—the components. The Constellation platform would provide the mechanisms for assembling the components, protecting some of the assemblies from being disassembled (for program copyright protection), and letting users and vendors freely recombine some assemblies to construct new applications out of existing ones.

The entire Constellation platform was supposed to be portable. As first described in March 1991, Constellation would run on OS/2 2.x, AIX, OSF/Unix, PenPoint, the Mac (depending on the capabilities of System 7.0, which had not been released at that time), and 32-bit Windows.

The Pink operating system has been shrouded in mystery. All we know for sure is that the system is object-oriented. From remarks concerning the design of portable systems made by Edward Birss, senior vice president for object-based systems at Apple, you can assume that cross-platform design was part of the work done on the system. Pink is said to consist of about 1 million lines of code, the result of years of effort at Apple.

If Taligent represents a merging of these two technologies, you can expect an operating system that uses an object-oriented model from top to bottom, from the API to the GUI. Above a small, machine-dependent kernel, user- and system-interface services are likely to be implemented as object classes. Programs will be similarly object-oriented. Code will consist of objects, and the programs themselves will also be objects—coarser-grain objects, or components. The user interface will provide mechanisms for encapsulating the objects, or, in Constellation's parlance, the *assembling components*.

On the other hand, there is no assurance that Apple and IBM will accomplish any significant amount of technology sharing. Reports coming out of the two companies tell of Apple engineers' low regard for Metaphor software and of Apple employees' unwillingness to work directly for the former president of Metaphor, David Liddle. The reported discord bodes ill for Taligent as a business and as an operating system. We will have to wait and see—probably until sometime around 1995.

Will Programming Get Easier?

The operating systems of the next decade will probably consist of four versions of Unix, one of Windows, and one altogether new breed. The new systems will do more work for the developer. They will put cross-platform design where it rightfully belongs: in the system software. The new operating systems will provide an extensive range of user-level services (e.g., interapplication communication, object linking, and distributed computing).

But nothing is free. As system software takes on more work, it also becomes more complex. Although solving many problems for developers, the new systems will also introduce new levels of complexity.

Programming environments are growing ever more complicated. Meanwhile, user expectations grow. The future of software development includes a programming environment with many more layers—software is expected to do more work more quickly. Operating systems will accomplish more, but no one is promising that, as a result, programming will become any easier. For programmers, somehow, the degree of difficulty remains a constant. ■

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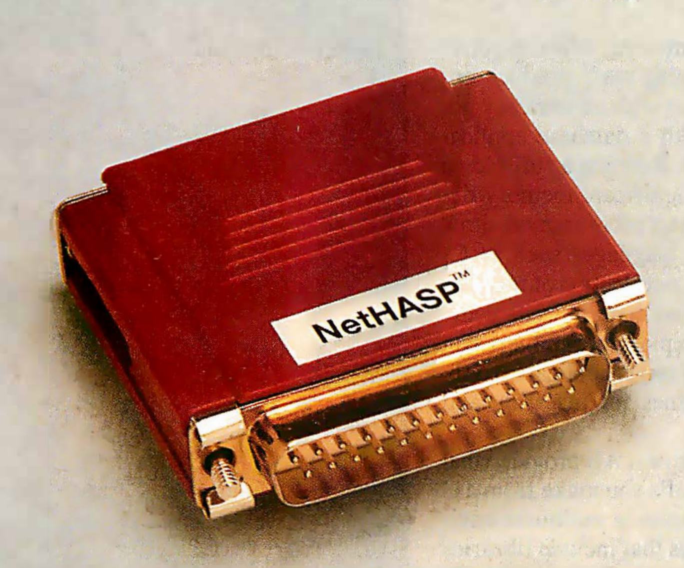
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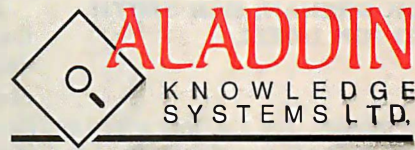
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DATABASE BUILDING BLOCKS

A database library lets you custom-craft your own database applications, but you must be ready to roll up your sleeves

RICK GREHAN, BEN SMITH, AND JON UDELL

Sometimes prepackaged applications don't cut it. Sometimes you really have to get *inside* a database to forge that program you are not able to buy off the shelf. Or perhaps your department requires an application that demands the kind of control you can get only from a carefully crafted C program. Maybe it is essential for you to be able to display graphics on-screen side by side with data fetched from a database: Just try doing that in dBase.

In-house programming often requires that the programming staff produce on-demand applications with an intricacy not easily achieved with a database applications builder. You also face speed and size considerations. Running a full-blown dBase or FoxPro environment, for example, can place significant memory demands on the workstation. Database development libraries let programmers draw on the flexibility and power of standard programming languages such as C, C++, and Pascal. Essentially, you buy a database engine: a collection of routines for creating and manipulating databases that you'd rather not have to write yourself. Some libraries actually include source code, so intrepid programmers can incorporate only those routines they actually need. If your target application only searches a database, why force it to carry around routines for inserting and deleting?

In this review, we examine seven software database engines. All provide what we call "low-level" access to database files via function calls you make from a C or C++ program. Additionally, all the packages can operate in multiuser environments, either on networks or under Unix. The packages that include libraries for DOS and DOS-based networks are Btrieve 5.10 Developer's Kit from Novell, CodeBase 4.2 and CodeBase++ 1.05 from Sequiter, db_Vista 3.20 from Raima, and Paradox Engine 2.0 from Borland. The two entries for Unix are db_Vista in its Unix incarnation and c-tree Plus 6.0 from FairCom.



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BYTE ACTION SUMMARY

WHAT DATABASE LIBRARIES DO
These libraries give programmers low-level access to database files.

LIKES
For programmers looking to wrap an application around a database, these packages provide the only real alternative to building a database application from scratch.

DISLIKES
The low-level access that these products provide makes them powerful but difficult to master.

RECOMMENDATIONS
If you're already using dBase to manage your databases, CodeBase 4.2 or CodeBase++ 1.05 will let you keep your files while integrating specialized database applications into your workplace. Otherwise, db_Vista 3.20 is a powerful package that you can run under DOS, Unix, NetWare, and most PC-based networks.

How Low Is Low?

We should be careful here about the term *low-level*—it's easy to misinterpret it in the multilevel realm of database programming. Some Structured Query Language (SQL) programmers may think that Clipper is a low-level environment, while Clipper programmers may view carefully rolling a database written entirely in C as low-level programming. Using a database library like the ones reviewed here places you somewhere between a Clipper programmer and a poor soul building a database system in C from scratch.

As its name implies, a database library provides you with a collection of functions that you can link into a program. Generally, these functions give your program access to two kinds of files: data files and index files. Data files consist of the information stored in your database. Typically, a data file looks like a series of fixed-length records composed of fields.

Certain fields within a record are unique for that record and specify the route by which the record will be accessed. For example, in a database of student records, the social security number of each student is unique. There will be reports to run that require access to student information via the SSN. Such unique fields are referred to as *keys*, and

Database Glossary

B-tree A data structure that is especially suited for manipulating a large collection of keys on secondary storage devices. The B-tree derives its name from its treelike structure of pointers.

field A member of a row that holds a data value associated with an attribute.

index A collection of keys, usually stored in a disk file. The keys within an index are embedded in some data structure that facilitates rapid searching, inserting, and deleting. Such data structures can include hash tables, binary trees, and B-trees.

ISAM (indexed sequential-access method) An ISAM system lets you access records within a file in either indexed or sequential fashion. *Indexed access* is a form of random access: You specify a value for a field, and the system fetches one or more records that satisfy that specification. *Sequential access* means that you can access records in ascending or descending order based on the value of a field. In both cases, it's understood that the target fields are key fields.

join A merging of records from two or more tables to create a resulting table. The merge is usually guided by a common field.

key A data quantity composed of one or more fields from a record. A key's value is often unique. Keys are kept in an index, and each key usually has an attached data pointer that leads to the associated data record.

rollback The act of returning a database to some previous state, usually on the failure of a transaction.

row Physically, a row is usually a record in a data file. Logically, a row is one horizontal member of a table: a collection of fields.

table Usually, a collection of rows all stored in the same logical file. In some cases, a table also includes any indexes associated with the data.

transaction A collection of operations on a database whose processing is considered to be atomic. That is, if any operation within the transaction fails, all operations fail, and the database is returned to the state it was in prior to the execution of the first operation (see *rollback*).

union The process of combining specified rows from two tables into one table.

keys are typically kept in a separate file called an index file.

Inside an index file, keys are arranged in one of several structures that permit rapid insertion, deletion, and retrieval. Often this data structure is a B-tree, a kind of elaboration on the binary tree. A data-record pointer is associated with each key in the index file. (For more on B-trees, see "Trees 'n Keys," January–March 1989 BYTE.)

Many database libraries provide functions that distinguish between key fields and other fields. Such functions are necessarily aware of the relationship between keys in the index files and data in the data files. You need only call a routine that searches for any record with a particular field matching a particular value. The library routine will search the index for the matching key, fetch the data pointer, and use that to retrieve the associated record from a data file.

Programming with a database library requires not only that you map out key fields but also that you be intimately familiar with the internals of your records. In many cases, you are working at the level of C structures. Some packages help you maneuver through the internals of a record with collections of "field-handling" routines that can manipulate various data types. Once you have specified the layout of a record, the field-handling routines let you extract from or store into the record such things as strings, dates, numbers, and sometimes specialized data types, such as currency.

Elaborate database operations familiar to SQL users (e.g., *joins* and *unions*; see "Database Glossary" at left for definitions of these and other terms) must be constructed manually if you're using a database library. A database library provides record-at-a-time access; hence, any database-wide activity, such as a join, turns into a loop that must examine each record in the member data files. However, there's a universe of database activities for which record-at-a-time access is sufficient. Point-of-sale order entry, reservations tracking, and inventory searching represent three good examples.

To test the database libraries, we developed a simulated inventory system complete with a parts table, a suppliers table, a salesman table, and an orders table. We developed programs to run the same tests on each package (for details about the performance tests, see the text box "Racing the Engines" on page 210).

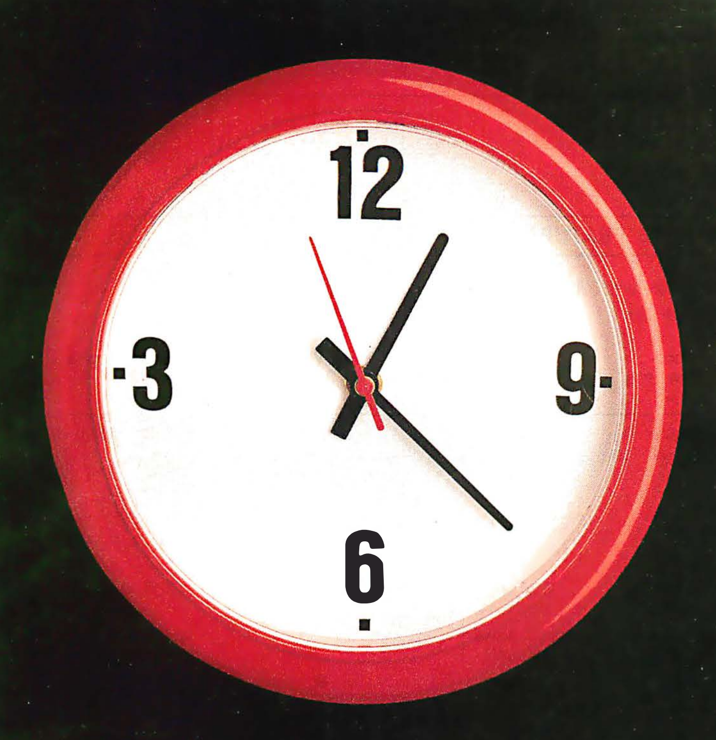
Besides giving us a handle on the performance of each package, developing our inventory application enabled us to uncover the important similarities and differences among the libraries. We have given a blow-by-blow features list in the table. More subjective analysis follows.

Btrieve 5.10 Developer's Kit

Most of the packages we examine here are strictly libraries of code; Novell's Btrieve is the exception. Btrieve is a record manager that can be either a DOS TSR program (for single-user DOS applications) or a combination of a server-based record manager and workstation-based Btrieve requesters. In the single-user configuration (which we tested), the record manager is a TSR that hooks interrupt vector 7B hexadecimal. In a server-based scenario, each workstation runs a Btrieve requester TSR that redirects calls to the record manager running on the network server. The server-based record manager is implemented as a NetWare loadable module (NLM), which is included with NetWare 386.

The Btrieve Developer's Kit helps you build client applications for the Btrieve record managers. For $595 you get the DOS TSR version of the Btrieve manager; source code files for building interfaces to Btrieve for high-level languages such as C, BASIC, and COBOL; and several utility programs for things like file repairs and crash recovery.

Btrieve's design has two advantages. First, the single-user manager and the server-based managers both look the same to client applications. You can write a Btrieve client application using



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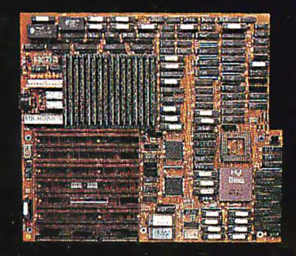
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DATABASE ENGINE FEATURES

All packages support at least C programming in the DOS environment. Many support a variety of languages and environments, from VMS to Microsoft Windows. (● = yes; ○ = no.)

	Btrieve 5.10 Developer's Kit	CodeBase 4.2	Code-Base++ 1.05	c-tree Plus 6.0	db_Vista 3.20	Paradox Engine 2.0
Company	Novell	Sequiter	Sequiter	FairCom	Raima	Borland
Price	$595	DOS: $295 Unix: $495	$295[1]	$595	Single-user DOS: $895 Multiuser DOS, $1295 SCO Unix: $1895	$495
Languages supported	C, Pascal, BASIC, COBOL, others	C, C++	C++	C	C, C++	C, C++, Pascal[2]
Operating environments	DOS, Windows, OS/2	DOS, Windows, OS/2, Unix	DOS, Windows	DOS, Unix, Macintosh	DOS, Windows, VMS, Unix System V and BSD 4.2	DOS, Windows
Networks supported	NetWare	Any PC-based LAN	Any PC-based LAN	Any PC-based or Mac LAN	NetBIOS, Unix	Any PC-based LAN
Source code	○	●	●	●	●	○
Variable-length records	●	●[3]	●[3]	●	●	○
Key compression	●	○	○	●	●	○
Record locking	●	●	●	●	●	●
File locking	○[4]	●	●	●	●	●
Undelete	○	●	●	○	○	○
Transactions	●	○	○	●	●	○
Data-file encryption	●	○	○	○	○	●
Customizable sort orders	●	●	●	●	●	○
Key length	255 bytes	100 bytes[5]	100 bytes[5]	4 gigabytes	246 bytes	[6]
Data length	4090 bytes[7]	32 KB	32 KB	4 gigabytes	32 KB	1350 bytes[8]
Records per table	No limit	[9]	[9]	Depends on OS	16 million	[10]

1 Screen management routines are a $95 option.
2 Supports any language that supports DLLs.
3 Variable-length records supported with memo fields.
4 File locking is automatic within transactions.
5 dBase compatibility; 338 bytes for Clipper compatibility.
6 Record-length dependent.
7 Fixed portion. Btrieve allows up to 56 KB for the variable portion of a record.
8 Keyed tables. Nonkeyed tables can be up to 4000 bytes.
9 Depends on component fields.
10 Depends on record length; maximum table size is 256 MB.

the developer's kit, test it using the single-user record manager, and be reasonably confident that it will work on a NetWare network. Second, it is possible to call Btrieve from virtually any language. Novell's documentation provides you with sample source code for C, Pascal, COBOL, assembly, and even interpreted BASIC.

To write a Btrieve program, you have to be willing to get down. You access Btrieve functions by loading up a parameter table, placing the address of that table in a CPU register, and calling an interrupt. The parameter table is a block in memory that carries a set of pointers to the current record buffer, the current key buffer, the position block, and similar information. Fortunately, Novell provides an interface routine that wraps a function call around the interrupt call, so you end up with a standard-looking C function. Btrieve files consist of pages (i.e., fixed-size blocks on the disk). Btrieve will not let fixed-length records cross page boundaries, so any space left on a page after Btrieve has filled it with the records is wasted. You specify the page size when you create a Btrieve file, which lets you minimize wasted space.

When you begin designing a Btrieve database, you'll be glad to find an entire chapter in the documentation devoted to calculations of page size.

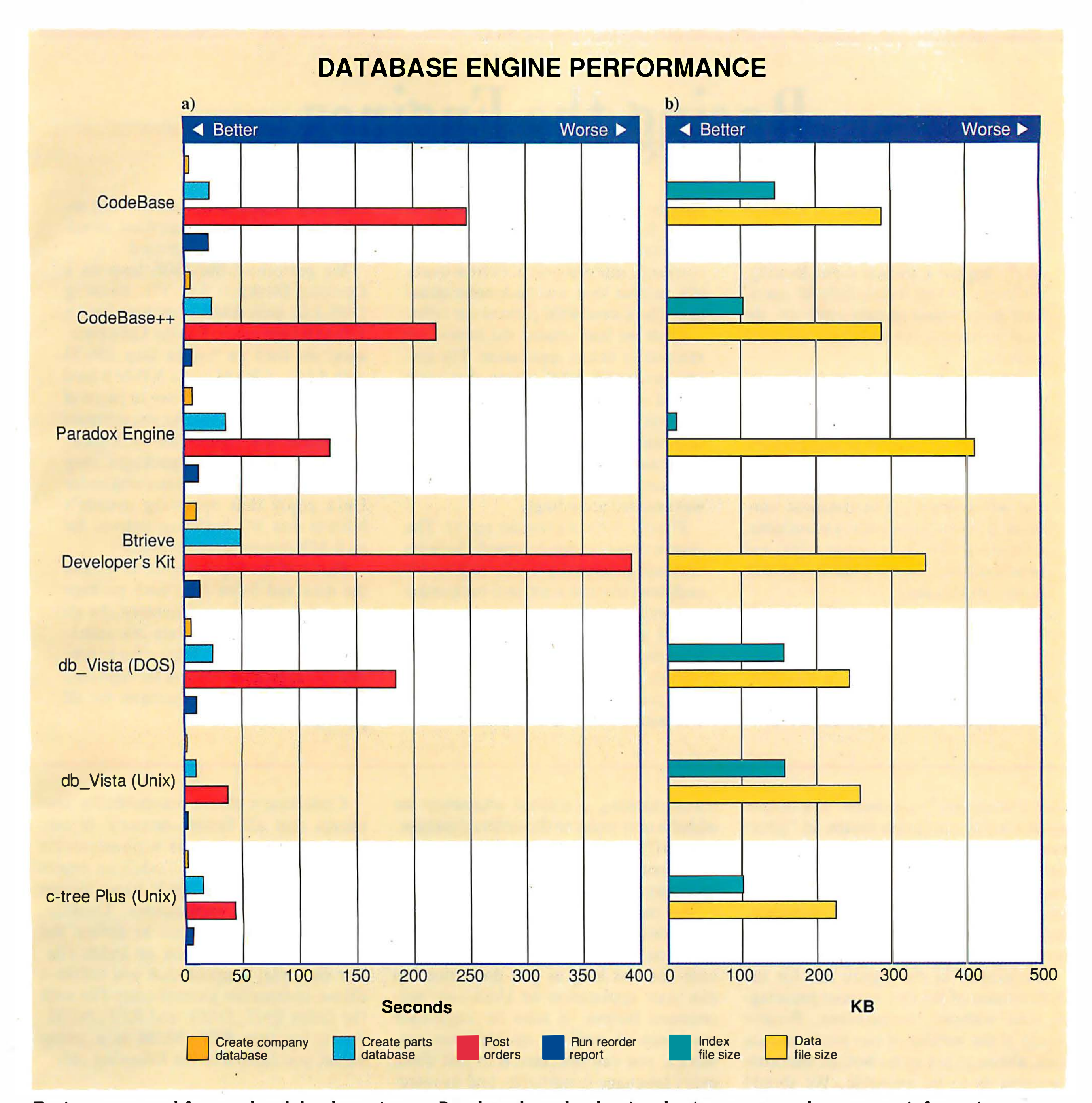
A Btrieve file is a collection of pages. All data and all data-index information reside in the same file. Each page is either a data page or an index page. An index page holds keys, and a data page holds records. Each Btrieve file can contain the equivalent of one data file and several index files; Btrieve's file organization is often referred to as "super files." If you examine part b of the figure, you'll see that Btrieve's file size appears larger than that of files created by other packages. This is an effect of combining index and data into a single file. (However, the total disk space taken up by each package is roughly the same.)

Btrieve's keys can be multisegmented, which means that a single key can be the concatenation of various portions (fields) of the data record. When you create a key, you specify its component field offsets, their types, and their lengths. You can also specify whether each segment is sorted in ascending or descending order. For example, you can build a key constructed of dates in descending order and check numbers in ascending order. This would let you print a report showing most recent checks first.

Btrieve supports alternative collating sequences for all 255 ASCII codes. You can completely respecify how one ASCII code sorts with relation to another, so you can have B sorting before A and Z sorting before B, if you like.

We were impressed with Btrieve's fine-tuning options. As we mentioned above, Btrieve constructs indexes that place keys on fixed-size pages. As your program adds more keys to the file, the pages fill up and their contents must be redistributed to new pages. You can specify whether Btrieve is to be intelligent about this redistribution process. If you choose intelligent redistribution, Btrieve tries to keep key pages packed as densely as possible. Otherwise, it simply distributes the keys so that pages are at least half full. The former produces indexes that are smaller and quicker on read operations but slower on insert operations; indexes produced the latter way are larger, but they are quicker on insert operations.

Btrieve 5.10's most interesting new feature is its support for extended func-



Engines compared for speed and database size: **(a)** *Benchmark results showing the time to create the company information and parts databases, followed by the times to post orders against the parts database and run a reorder report. Shorter bars mean better performance.* **(b)** *File sizes (in KB) for the 4000-record orders database. Notice that Btrieve keeps both index and data in a single file.*

tions. Extended functions permit you to operate on multiple records with a single call; for example, you can insert a set of four records with a single call to the Btrieve insert function.

Btrieve has various levels of file recovery and data-integrity protection. It supports crash recovery with *preimaging*. With preimaging activated, a copy of the page about to be changed is written to a preimage file before the file is modified. Btrieve will discard the preimage file's contents only after the operation is complete. If the system crashes before the operation has finished, Btrieve can use the preimage file to restore the original file to its state prior to the crash.

For even tighter safeguards, you can use Btrieve's transactioning system, which handles rollback. Btrieve can group a set of operations into a single atomic transaction. Once you execute a "begin transaction" command, any subsequent file that you access is automatically locked. This keeps other users from modifying files controlled by your transaction until you have executed an

Racing the Engines

Database developers can appreciate the elegance of object-based field access and the utility of a logical approach to file locking, but these factors mean little to users. Next to questions of data integrity, the most important consideration for users is speed.

Naturally, the engine you choose will make a big contribution to the speed of the application you develop. We chose an inventory application of intermediate size to get a feel for the kind of performance you can expect from the products that we reviewed. The database consisted of four components: a parts table, a suppliers table, a salesman table, and an orders table. We ran a number of tests against this database.

First, we created the suppliers table. The system read an ASCII-format data file and created the table. Each record included an ID number, a company name, an address, and a phone number. Our suppliers table consisted of 1000 entries. Next, we created the parts table. Each record here consisted of an ID number, a description, a supplier, cost each, sale price each, current quantity, reorder level, and back-order quantity. There were 4000 parts in our table.

Once we had created the tables, we ran a daily orders application. The system generated 4000 orders that were posted against the parts table. Additionally, the salesman table was updated to tally each salesman's current sales. If the quantity in inventory dropped below the reorder level, the back-order field was updated accordingly.

Finally, we ran a reorder report. The system simply stepped through the parts table and generated a reorder request for each item that had a nonzero back-order amount.

The idea was for the tests to mimic what might take place in a real-world inventory management system. Orders were posted against the inventory table; salesman records were updated to record year-to-date sales; and reorder reports were run so that depleted inventory items could be replenished.

We performed our DOS tests on a Compaq Deskpro 386/33L running DOS 4.01 with 4 MB of memory and a 120-MB hard drive. For the Unix packages, we used an Everex Step 386/33 with 8 MB of RAM and a 300-MB hard drive. The results are shown in part a of the figure on page 209. As you compare the benchmark figures for DOS packages with those for Unix packages, keep in mind that applications running under Unix enjoy that operating system's built-in disk I/O buffering (which, for an 8-MB system, is substantial).

Part b of the figure shows the size of the data and index files each package created for the parts inventory. In all cases, we used neither data- nor index-file compression. It is interesting to note that the aggregate file size for both data and index files was comparable for all packages.

"end transaction" command. If a failure occurs or your program issues an "abort transaction" before the transaction completes, then changes made to any files since the "begin transaction" command are discarded. Keep in mind, however, that activating transactioning can significantly degrade performance.

The graphs in the figure are for the DOS version of Btrieve without preimaging and without transactions. Btrieve scored at the bottom of our performance tests, although not so far behind the other packages as to be unusable. We should point out that we did not specify index compaction when we started Btrieve. Consequently, insert operations performed well, but search operations were probably less than optimal. We also tested the NLM version of Btrieve on a 486-based Dell server with 16 MB of RAM. As expected, those parts of the benchmark that depended heavily on search operations showed a significant performance improvement, running as much as four times faster than the non-NLM version.

To test the overhead for transactions, we ran the daily orders portion with transactioning activated whenever we added a new order to the orders database. The difference was significant—times rose from an average of 392 seconds to an average of 1200 seconds.

You may find yourself developing applications in various languages that must draw on the same database. In that case—and as long as you don't need to run your application on Unix—we recommend Btrieve. It runs on single-user machines as well as on NetWare networks, you can interface it to just about every language imaginable, and its integrity and crash-recovery features are top-notch.

CodeBase 4.2

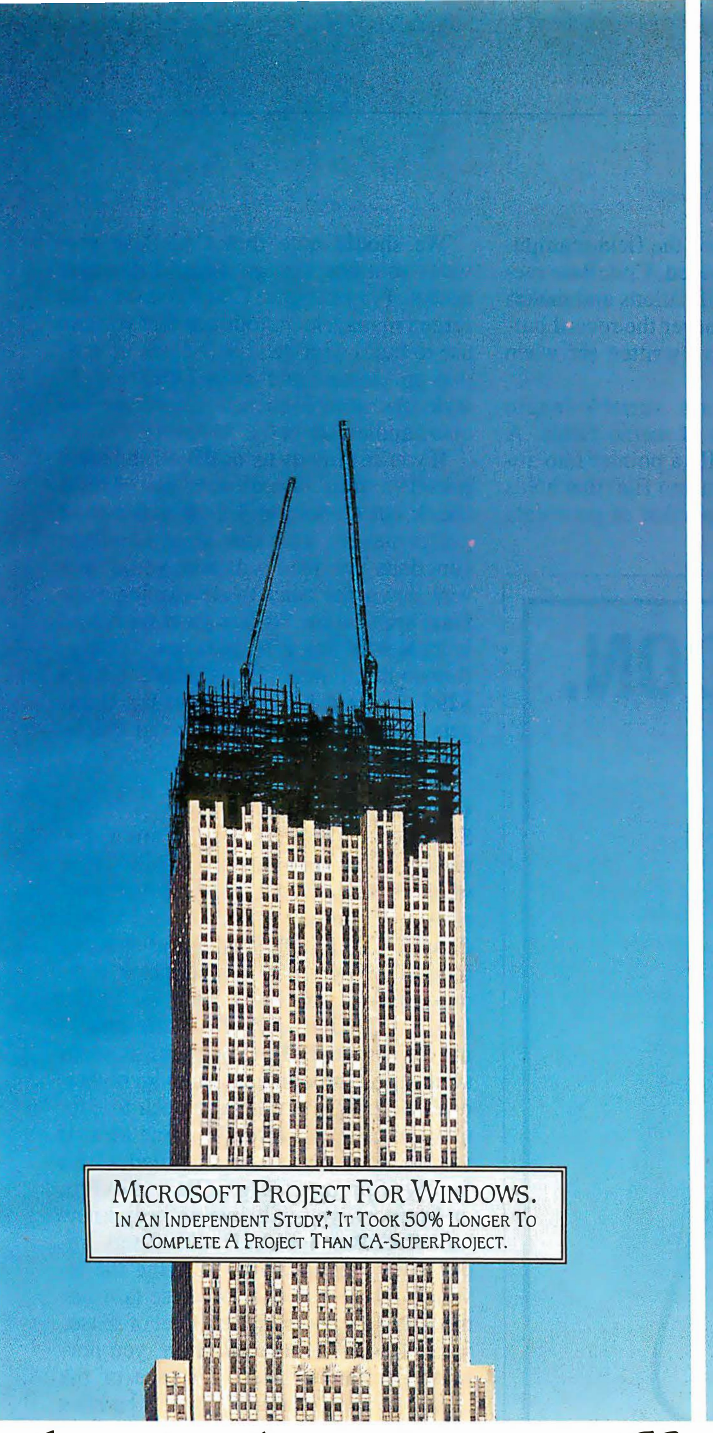
If you're already using dBase, you might consider development with a library that can understand dBase files. Sequiter's CodeBase 4.2 easily digests dBase-compatible files, which means that you can rapidly integrate programs written in CodeBase into your existing system. Data and index compatibility is clearly a valuable asset, since a big chunk of the world's PC-resident data is tied up in .DBF files.

CodeBase's dBase compatibility also means that all fields—numeric or otherwise—are stored as alphanumeric strings. Interestingly, CodeBase boasts special routines that let it parse strings carrying dBase expressions. Usually, you'd use these routines to define the structure of keys within an index file. For example, suppose that you define a dBase-compatible journal-entry file with the fields ENT_DATE and REF_NUM. Assuming that REF_NUM is a string value, you can make the following call:

```
data_ptr=
e4eval("DTOS(ENT_DATE)+REF_NUM")
```

and the static variable `data_ptr` will receive a pointer to an internal field holding the result. You can use this result to construct the key with which your program would search an index that is sorted by date and reference number.

Our biggest complaint with CodeBase is its odd naming convention. For example, `d4go()` means "read the specified record into the record buffer." We assume there is some connection (however tenuous) to the dBase verb GO, but we





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* March 1991 study published by 1Soft Decision, Inc., including CA-SuperProject 2.0, Microsoft Project For Windows, Symantec's Timeline 4.0, ABT Project Workbench and Scitor's Project Scheduler-5.

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never became fully accustomed to the convention.

The CodeBase data-access model assumes one active database at a time. To do anything with a database, you must activate it with a call to `d4select()`. From that point on, all the database functions target that database. You don't have to explicitly tell each function what database you're working on.

You also don't need to explicitly tell CodeBase to write a record once you've modified it. If you use the field-manipulation functions provided, CodeBase recognizes record modifications and makes updates to disk whenever the record buffer is about to be overwritten (or when you close the file).

CodeBase supports variable-length records in the form of memo fields. A memo field is actually a pointer into another file (i.e., the memo file) that holds the variable-length portion of your data records.

We should note that CodeBase provides routines that go beyond database access. For example, CodeBase includes screen management routines that you can use to build windows, pull-down menus, pop-up menus, and even Lotus 1-2-3–style hierarchical menus. CodeBase can also handle data-entry chores.

If you're already using dBase and must preserve your investment, you should check out CodeBase 4.2. It gives good performance, and the input-handling functions provided will take you a long way down the road to developing your final application. Its one great weakness is its lack of any kind of transactioning. Remember, though, that CodeBase 4.2's $295 price tag for DOS ($495 for Unix) gets you the complete source to the library.

CodeBase++ 1.05

Sequiter's CodeBase++ wraps C++ packaging around the core functionality of CodeBase 4.2. Like its procedural cousin, CodeBase++ reads and writes dBase IV data (.DBF) files and multitag index (.MDX) files and supports standard dBase primitives such as SKIP, GO, RECNO, and ZAP. While retaining the essential dBase verbs might seem strange in a product that takes an object-oriented programming approach to data management, it's actually a fine idea. If you've used any of the so-called xBase family of products (e.g., dBase, FoxPro, or Clipper), you will instinctively know how CodeBase++ deals with filters, index files, and locking. Bringing the leverage of C++ to bear on these familiar mechanisms makes a great deal of sense.

In a CodeBase++ program, you normally declare a single instance of the class named `CodeBase`, which handles errors and stores global settings on behalf of one or more database objects. Next, you declare the database objects. The database classes form a hierarchy. Class `Data` defines the basic .DBF capability, but you're more likely to use its child, `DataIndex`, or its grandchild, `DataMemo`. The idea is that your program need accrue only minimum overhead. If you require index files but will not be needing memo (i.e., variable-length character) fields, use class `DataIndex` and avoid linking in the extra memo-field functions of class `DataMemo`.

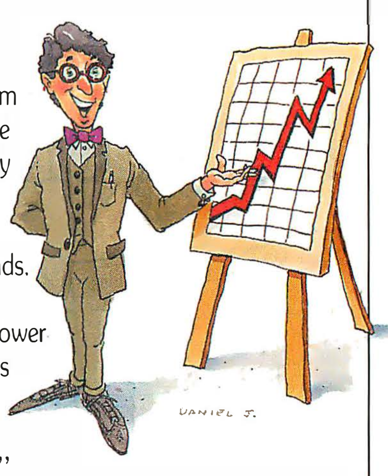
You use the separate database class `DataFilter` to restrict the set of available records. With the dBase equivalent (SET FILTER), you supply an expression that defines the filtered record set (e.g., `SALESMAN == "JONES" .AND. ORDERS > 100`). Similarly, in CodeBase++,

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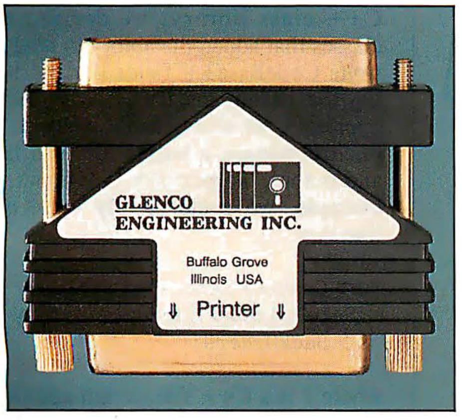
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you can declare instances of class `Expr` that you use to evaluate arbitrary dBase expressions. Expressions can be useful not only for filtering but also for index creation and interactive querying. More general-purpose classes include `Date` and `LinkList`.

There's also a set of field classes. These classes naturally derive from the string class `Str`, because .DBF files represent all kinds of data, including dates, numbers, and Booleans, as characters. Class `Field` handles character fields. More specialized field classes, such as `DField`, `NField`, and `MField`, derive from `Field` and handle date, numeric, and memo fields.

Class `Str` overloads comparison operators, such as `==` or `<`, and type-casting operators, such as `int` and `double`. The field classes inherit these operators, and that makes field objects extremely easy to use. To compare the contents of a character field called SALESMAN to the contents of another character field called LASTNAME, you can simply write `if (LASTNAME == SALESMAN)`. Or, if ORDERS is a numeric field, you can write `(long) ORDERS * 100`, casting the field's digits to a long integer on the fly.

The field classes themselves define—and overload—the assignment operator to ease dealing with differing data types. To assign the value 100 to ORDERS, you can write `ORDERS = (double) 100` or `ORDERS = "100"` or `ORDERS = QUANTITY` (where QUANTITY is another field object).

CodeBase++ makes fields into first-class data types that you can treat just like C integers and strings. That meant that our CodeBase++ version of the test program could use fields directly, without requiring a raft of intermediate variables. Our first cut at the program, however, did use extra variables to help move data from text files into the databases and from the databases back out to the report file.

Then we rewrote the program to exploit the power of C++. From the input and output stream classes in the Borland C++ class library, we derived new classes that added the ability to read and write CodeBase++ fields. By overloading the stream insertion and extraction operators, we eliminated the need to explicitly manage a buffer for field input and output. To perform field input, for example, we could simply write code like this:

```
f >> Cost >> Description >>
  SalePrice >> CurrentQuantity
 >> BackOrders;
```

where `f` is a C++ file stream and `Cost`, `Description`, and the rest are CodeBase++ fields.

The end result was a program that was shorter, more readable, and more maintainable than any of the other solutions. Whatever the other merits of CodeBase++—and they are considerable—its C++ orientation makes it a compelling choice. It was quite straightforward, for example, to build a windowed database browser by blending the text scroller developed in one of the TurboVision sample programs with CodeBase++ database and field objects. Also, because CodeBase++ provides a dynamic link library, we could have done a Windows version of the browser in terms of Borland's Object Windows Library.

Like dBase, CodeBase++ handles basic record and file locking automatically. When you seek to a record or append a new one, it locks the record; when

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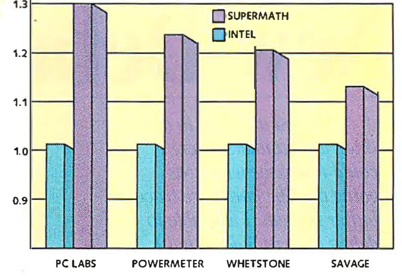
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you reindex or zap a database, it locks the database and associated index file. If you're using only one of many tags in an index file, CodeBase++ will lock the entire index file when it updates that tag—which could cause a lot of contention in certain situations.

However, there is no equivalent to the dBase SETRETRY command, which specifies how long to wait for a locked file. CodeBase++ defaults to infinite retry with a 1-second wait; if you disable waiting, it returns immediately with an error. To get reasonable throughput in the multiuser order-entry test, therefore, we disabled waiting and explicitly polled for locks on the orders file.

CodeBase++ supports Turbo C++, Borland C++, and Zortech C++. Commendably, Sequiter provides full source code so that, with some fiddling, you should be able to use the class library with any compiler that supports AT&T C++ 2.0. CodeBase++ costs $295 without the screen-handling routines that you will find in CodeBase 4.2. If all you need is a database engine, you're set; but if you want to incorporate 4.2's screen handling in your CodeBase++ programs, you can have them for an additional $95.

c-tree Plus 6.0

As with CodeBase++, the c-tree Plus libraries are distributed as source code. We tested c-tree Plus under SCO Unix, but the code is portable enough to make it useful for most Unix implementations. The library we tested sells for $595. FairCom also markets a version for building DOS applications.

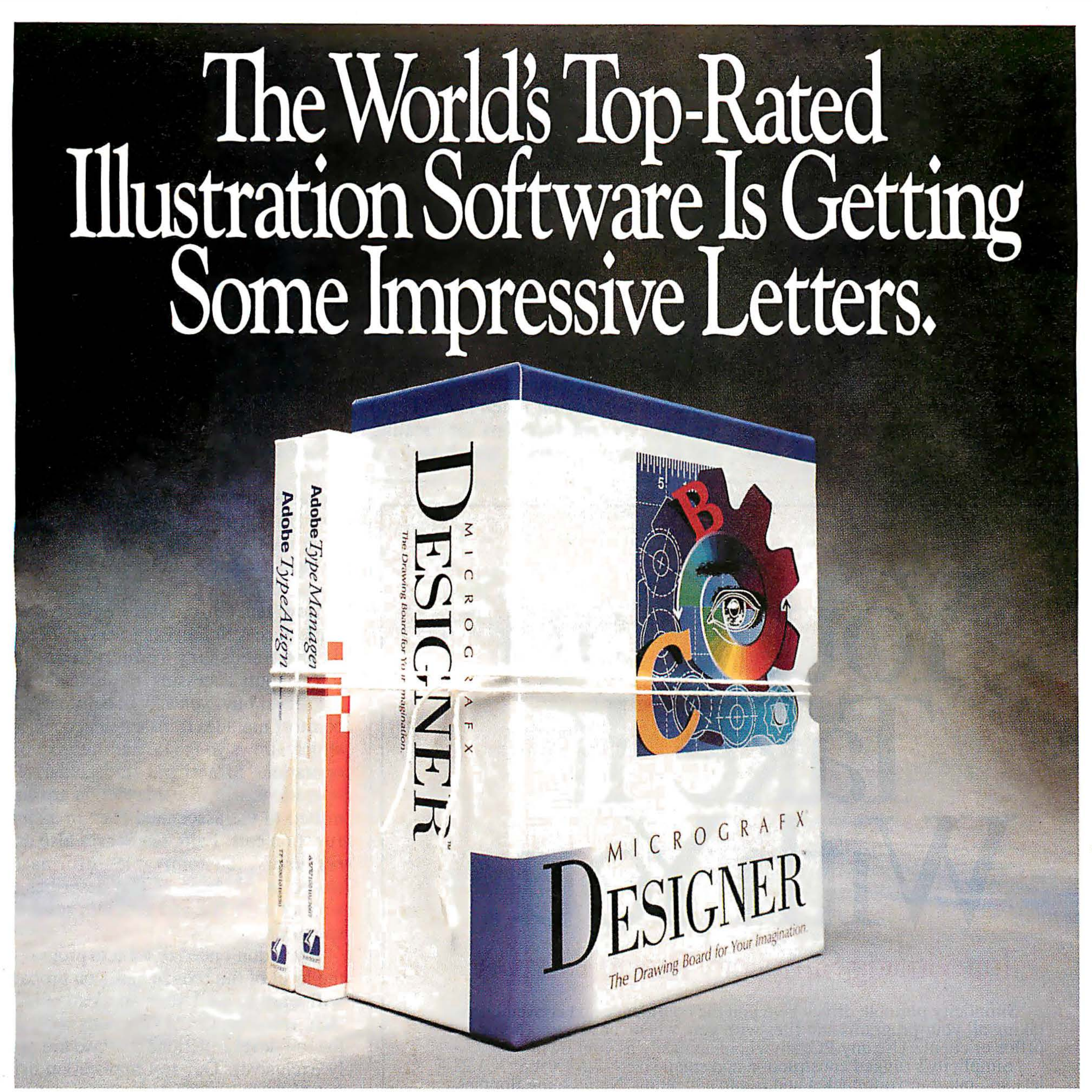
To get under way, you run a script program to compile the library modules and utilities. In this way, you can be sure that the library object files are compatible with your development system. You can use c-tree Plus to generate stand-alone programs or to build client applications for FairCom Server, a database server that FairCom markets for Unix systems.

There are three distinct levels of database programing with c-tree Plus: what we've been calling low-level, ISAM, and SQL. We built our sample application using both low-level and ISAM techniques.

c-tree Plus is remarkably flexible. You can program with fixed-length or variable-length data records. If you are programming with the low-level functions, you have several options for how the key values are stored in the index file: fixed-length keys (the fastest), leading-character compression (less file space, particularly for keys that are very similar), padding compression (a variable-length key useful when there is variation in key data), and a combination leading/padding compression when file space is more important than speed.

At the low level, programming with compound keys (i.e., keys that are composed of several key fields) requires additional code for building and breaking down the compound keys. At the ISAM level, however, you can define compound keys from the start, and the ISAM routines know how to handle them. One of the most valuable skills in database design is knowing when to use compound key files, which keys should be combined, and which should have their own index files.

Programming with the low-level functions requires a great deal of planning and care—and lots of lines of code. For each step in a database operation, you must program the relationship between the index files and the data files. Even



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after you create the files, opening each requires a file ID, a filename, and an access mode. And all this is independent of the structure that you intend to stash in each record.

Nonetheless, the 39 functions that constitute the low-level library provide all that you need. (There are an additional five functions for variable-length records.) These data-record-manipulation functions handle basic record functions such as create, lock, unlock, read, and write; they also let you count and release records.

As records are released, they continue to consume space in the file. There is no function available that lets you rebuild the file and thereby return this unused space to the operating system.

The c-tree Plus low-level libraries also include an impressive collection of functions for working on index files. There are the expected functions for creating and deleting key entries; searching for a specific value, the first value, and the last value; and stepping forward and backward through the index file. But there are also functions for searching for key values greater than, greater than or equal to, less than, and less than or equal to a target.

There is a nasty twist to all this flexibility with keys and indexes, and that is that the data in the key-field space is typeless. It's merely a string of bytes. This means that when you create a key string, you cannot simply terminate the string with a null character; all characters are considered significant up to the length of the key. You must pad the entire string space with nulls (or some other character).

Low-level programming gives you some access to FairCom Server. In spite of the necessary reduction in data throughput, accessing the data through the server buys you a lot of comfort. This comfort includes transaction accounting, which allows you to tie multiple database operations to a single transaction. The operations within a transaction are committed to the associated files in a single function call. FairCom Server also adds *resources*, customizable information stored in file headers that describes the state of each file and provides some file specifics.

If you don't need or want to program at the level of the bronze age, you probably will want to start your application using the c-tree Plus ISAM functions instead of the low-level functions (the two are nearly exclusive). Our test application using ISAM took 30 percent less code than the low-level version.

The biggest saving in code and effort comes about because the relationship between indexes and data files is defined outside the source code. The catch is that the file that defines these relationships (i.e., the parameter file) consists of a Byzantine organization of data-file and index-file parameters and descriptors (see listing 1). Fortunately, once you have got past writing the parameter file for your database, you're on easy street. All you need to do to find a record in your data file is to issue a `GetRecord` from an associated index file. Likewise, adding new records with their associated keys in the index files is a simple single step.

You can avoid the parameter file by hard-coding definitions for all the parameters and relationships using IFIL, IIDX, and ISEG, the internal `typedef` structures for incremental ISAM file operations. These structures contain essentially the same information as the

Listing 1: *The parameter description file for c-tree Plus ISAM programming. The information in this file is scanned whenever the database is opened. The indentation reflects the hierarchy of data structures used internally by ISAM functions to describe the relationship of indexes and data records. Compare this description method to the DDL file used by db_Vista (see listing 2).*

```
12 4 4 4
  0 parts.dat 54 0 1 1 pt_del pt_last
    1 parts.idx 9 0 0 0 0 1 0 0 1 pt_key
      0 9 0
  2 company.dat 70 0 1 1 co_del co_last
    3 company.idx 9 0 0 0 0 1 0 0 1 co_key
      0 9 0
  4 orders.dat 31 0 1 1 or_del or_last
    5 orders.idx 9 0 0 0 0 1 0 0 1 or_key
      0 9 0
  6 salesman.dat 19 0 1 1 sm_del sm_last
    7 salesman.idx 4 0 0 0 0 1 0 0 1 sm_key
      0 4 1
```

parameter file but give you the flexibility of working with the database either as a complete entity or as a collection of data and index files. This means that you can trim the number of buffers for open files down to the minimum needed for the operations at hand. Be warned, however, that working with these structures is almost as complicated and confusing as groping your way through the parameter file.

Unfortunately, the low-level complications of building the key fields for index files also apply to ISAM records. You will want to use the special function `TransformKey` for building anything more complex than the simplest character-string keys. There is no performance cost associated with using the ISAM functions. In fact, since the error handling is simplified, you may find that your ISAM code is faster than your low-level code.

c-tree Plus gives you a library of flexible database functions for developing a wide variety of applications. Performance is good, and the design is outstanding.

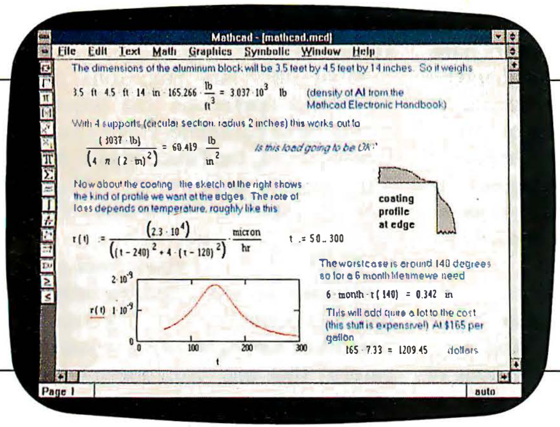
db_Vista 3.20

If you prefer not to feel the earth of database development between your toes and would rather travel by coach, you may prefer the db_Vista libraries and utilities from Raima. What db_Vista may lack in low-level flexibility it makes up for in sophistication.

db_Vista is not based on the simple data-file and index-file design that is typical of relational database systems (although you can use it that way). Rather, db_Vista provides access to your data through the simple sequential method,

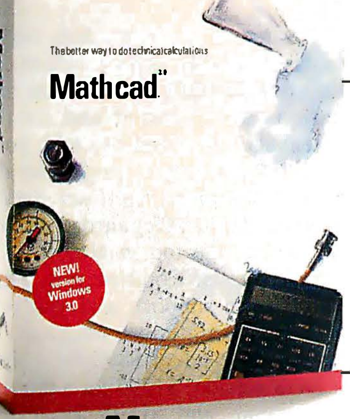


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Listing 2: *The DDL file for the db_Vista test database. The syntax is almost the same as that of C (in contrast to the syntax of the parameter file used by c-tree Plus ISAM). The db_Vista DDL processor utility generates a database dictionary and an include file from the information in the DDL file.*

```
database partlist {
 data file parts_dat =
  "parts.d01" contains parts;
 key file parts_key =
  "parts.k01"
   contains parts.stock_no;

 data file company_dat =
  "company.d01" contains company;
 key file company_key =
  "company.k01"
   contains company.co_id;

 data file orders_dat =
  "orders.d01" contains orders;
 key file orders_key =
  "orders.k01"
   contains orders.ref_no;

 data file salesman_dat =
  "salesman" contains salesman;
 key file salesman_key =
  "salesman.k01"
   contains salesman.id;

 record parts {
    unique key char stock_no[9];
    char description[16];
    char co_id[9];
    long cost;
    long sale;
    long curr_quan;
    long backorder;
    long reorder_level;
  }
  record company {
    unique key char co_id[9];
    char co_name[16];
    char co_address[21];
    char co_state[3];
    char co_zip[10];
    char co_phone[11];
  }
  record orders {
    unique key char ref_no[9];
    char stock_no[9];
    long quan;
    long backorder;
    char status;
    int salesman_id;
  }
  record salesman {
    unique key int id;
    char name[13];
    long sales;
  }
}
```

the familiar indexed method, and the set method.

The set method uses the network database model, a hybrid of relational and hierarchical models, and it allows you to organize your data as a tree of linked lists. The set method will be familiar to most programmers; for example, the model of inheritance in object-oriented programming follows the structure of sets.

Unlike the exclusivity of various levels of database library functions in c-tree Plus (i.e., low-level, ISAM, and SQL functions), the three access methods of db_Vista can be mixed within a single database. You can also develop programs that access more than one database at the same time. However, to do so safely requires you to become familiar with the db_Vista concept of current database state. At any given moment, the current state points to only one database and one record within that database. Any database operations that you specify are applied to that current state. This programming model greatly reduces the number of arguments passed to functions but requires additional functions to change the state from one record (or database) to another.

When you open a db_Vista database, you specify one of three modes in which you want to operate: single-user mode, shared-access mode, or exclusive-access mode. If you are new to db_Vista, we recommend that you prototype a multiuser application using only single-user mode. Once your application opens a database in shared or exclusive mode, it requires an access (lock) server (an external program that comes with db_Vista) to handle database-access requests. Since multiuser database operations require interprocess communications with the access server, the data-processing time can be two or even three times greater than that required for single-user access. For this reason, you should design data-access-intensive applications using exclusive or single-user mode with the database locked (i.e., batch mode). Only interactive operations should use shared file access.

To design a database, you define the records and indexes in a data description language file (see listing 2). Before compiling (or even writing) your application, you run the DDL processor utility, `ddlp`, to generate a header file that describes all the structures and alias `#defines` that pertain to your database description. The `ddlp` utility ensures that each database file has a unique handle and that the structures are appropriate for the application. The `ddlp` utility also generates a database dictionary file that the db_Vista functions use.

Most db_Vista functions perform high-level operations and require only two or three parameters. For example, to find a record, the function is `d_keyfind (field_ID, target, db_ID)`, where `field_ID` and `db_ID` are aliases defined by the database header file.

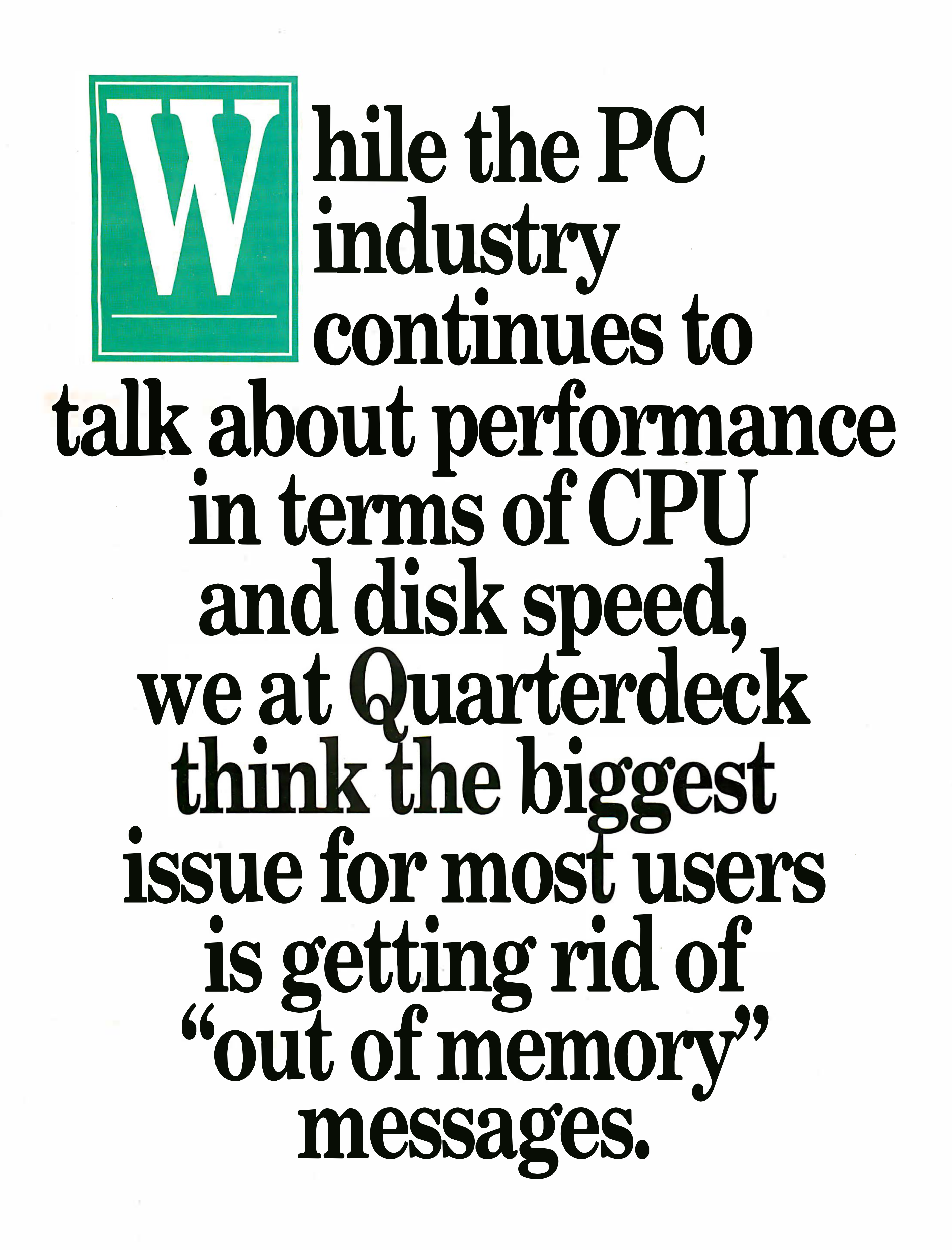
The step up from single-user access to multiuser access requires only a few more function calls but a significant amount of foresight, because you must be careful that one user doesn't lock another user completely out of the data. The access manager can queue requests with an application-specified time-out, but the application must include appropriate code to handle locking so that other users are not locked out of records and files for unbearably long amounts of time.

The value of db_Vista does not stop with the simplicity of its function calls. Its utilities simplify the business of applications development and database maintenance. db_Vista can take you all the way from a simple, single-user database to a complex, multiuser database with transaction safeguards. db_Vista performed at the top in almost all our benchmark tests. Combine that with its cross-platform support, and you've got one powerful database package. The price is a little steep: $895 for a single-user DOS version, $1295 for a multiuser DOS version, and $1895 for an SCO Unix version. But those prices get you source code and a royalty-free license, so the power may well prove to be worth the price.

Paradox Engine 2.0

Although the Paradox Engine provides database access at a very low level, while using it you always feel that you're working much higher—as though you were performing relational activities rather than simply reading and writing individual records. It's an illusion, of course. Much of the illusion comes from the relational terminology Borland uses in the documentation: A database is a "table"; a record is a "row."

The Paradox Engine places very tight controls on how your program accesses fields. When you build a table, you must first define a pair of arrays that you pass to the `PXTblCreate()` routine. One array specifies the field names within the table, and the other specifies the field data types. You build each record by writing into fields with calls to type-specific routines, such as `PXPutAlpha()`


While the PC industry continues to talk about performance in terms of CPU and disk speed, we at Quarterdeck think the biggest issue for most users is getting rid of "out of memory" messages.

and PXPutDate(), which write character strings and dates. In order to retrieve the contents of fields, you call the corresponding PXGetAlpha() and PXGetDate() routines.

Such routines allow the Paradox Engine to provide data types beyond those of standard C. They also add a level of protection, since it's unlikely that a programming mistake will overwrite a numeric field with a string. However, the result is code that is bulkier than that of a system that simply relies on C structures to map out the record structure (e.g., Btrieve).

Sometimes the Paradox Engine approach to data typing can get frustrating. Just extracting the contents of a record into a form that you can display requires a slew of function calls. We also wondered why the function for packing alphanumeric values (PXPutAlpha) does not require a length count, while its counterpart for extracting alphanumeric information (PXGetAlpha) does. Apparently, PXPutAlpha can derive length information from the field-definition array, while PXGetAlpha cannot. We suppose that the idea is to allow programmers to selectively unpack only a portion of a string, but that selectivity gets you only the leading bytes of the string. A properly placed memcpy() can achieve the same thing.

The Paradox Engine uses handles everywhere; you access everything through them. You make handles for files, handles for records, and even handles for each field within a record.

This handle concept gives the Paradox Engine added flexibility. Database packages like CodeBase provide only one record buffer per database. The handle orientation of the Paradox Engine allows multiple record buffers for each database. In this way, Paradox permits several different simultaneous views into a single database.

You can use the Paradox Engine in single-user mode or on a network. The library is compatible with a variety of network operating systems. However, you need to decide whether or not an application will run on a network at compile time, since you have to set constants to tell the engine what type of network you're running on, what your application's user name will be, and the directory where the PARADOX.NET file will be found. (PARADOX.NET is a file that the Engine uses to control concurrent access.)

Initially, we speed-tested the Paradox Engine using its defaults and with write-buffering off. This meant that the engine's own internal buffers amounted to only 32 KB and that all writes went immediately to disk. The effect was a painfully slow orders update. The results given in the figure show how the Paradox Engine performs with the write-buffering on and its own internal cache set to the maximum (256 KB).

The ability to turn write-buffering off is an important feature in critical situations where an up-to-date image on the disk is more important than speed. Such situations often occur in networked applications.

We tested the $495 Paradox Engine for Borland C. Borland also offers a Turbo Pascal interface that has two Turbo Pascal units—one compatible with version 5.5, the other with 6.0.

The Paradox Engine's documentation is superb. Borland provides the right number of examples at just the right level of complexity. The reference guide is easy to read and navigate through. Paradox fared very well in our benchmarks, leading the DOS pack in the post-orders test. Just as CodeBase will attract dBase users, so will the Paradox Engine attract users with Paradox databases already in place.

Check Out These Libraries

Although most of the packages are closely clustered in their performance times, db_Vista appears to be the overall winner in speed. We were impressed with the performance results for CodeBase and CodeBase++, especially since these packages use standard dBase index and data files.

However, your choice for a database library will be determined more by what your application requirements are than by a benchmarking horse race. To put it another way, it doesn't matter how fast a database package can run if it can't run on your chosen operating system.

If you want compatibility with existing dBase files, either CodeBase package will serve your needs. We really liked the simplified model of programming database applications in CodeBase C++. Likewise, if you already have a significant amount of data stashed in a Paradox database, Paradox Engine is the logical choice for you. For developing databases on NetWare LANs using almost any programming language, we would recommend Btrieve and the Btrieve Developer's Kit.

Our overall favorite is db_Vista. It scored at or near the top in the performance tests we ran. It's a powerful system loaded with all the features you'll ever need. Most important, db_Vista offers portability to a host of operating systems at a time when developing applications for diverse networks is often a critical requirement. ■

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FairCom Corp.
(c-tree Plus 6.0)
4006 West Broadway
Columbia, MO 65203
(800) 234-8180
(314) 445-6833
fax: (314) 445-9698
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Novell, Inc.
(Btrieve 5.10 Developer's Kit)
5918 West Courtyard Dr.
Austin, TX 78730
(800) 733-9673
(512) 346-8380
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Raima Corp.
(db_Vista 3.20)
3245 146th Place SE, Suite 230
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(206) 747-5570
fax: (206) 747-1991
Circle 1311 on Inquiry Card.

Sequiter Software, Inc.
(CodeBase 4.2, CodeBase++ 1.05)
9644 54th Ave., Suite 209
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(403) 437-2410
fax: (403) 436-2999
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Introducing QEMM 386 v6

Technology, art and magic make the best memory manager better still.

NEW

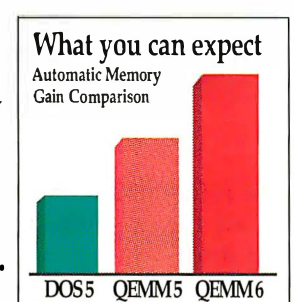
Stealth: The Ultimate Weapon.

QEMM 6 introduces an amazing new concept: Stealth. This new feature, *the first of its kind*, actually maps ROM into other areas of memory, resulting in a memory gain of up to 211K. Now you can load larger TSRs and device drivers into high-memory (the area above 640K), to give your applications more room. Stealth works on most IBM and IBM compatible computers.

NEW

New Optimize Makes it Easier.

QEMM 6 includes a completely new version of Optimize, the program which automatically configures and optimizes your memory. Now, it includes simple on-screen instructions, the ability to play "what-if" games, and a "view, browse and play" feature.



NEW

Squeeze: Flexible Memory at Start-up.

Often TSRs you wish to load into high-memory require more memory while they are initializing than they do once resident. Squeeze recognizes this, and can temporarily increase a High RAM region during a program's load and initialization.

NEW

Help for Beleaguered Laptop Users.

QEMM 6 now fully supports most battery-operated laptops, with detection of "suspend/resume".

Manifest Changes Destiny.

QEMM includes a copy of Manifest free. This amazing memory diagnostic and analysis tool is vital when configuring today's complex PC systems.

Much More Speed.

QEMM makes your machine faster, because it can place sluggish ROM into high-speed RAM. (QEMM is also a lightning fast memory manager.)

Even More Memory.

QEMM's VIDRAM feature extends *conventional* memory by 96K on EGA or VGA systems. VIDRAM disables graphics, but can easily be turned on or off.

Model	DOS 3.3 DOS Prog Size	Avail High Mem	Avail HMA	DOS 4.0 DOS Prog Size	Avail High Mem	Avail HMA	DOS 5.0 DOS Prog Size	Avail High Mem	Avail HMA
IBM PS/2 80	581K	211K	64K	572K	211K	64K	620K	211K	0K
Compaq 20e	581K	211K	64K	572K	211K	64K	620K	211K	0K
ALR VEISA	582K	211K	64K	573K	211K	64K	620K	211K	0K

More Memory by Default.

QEMM's Optimize will now, automatically, find up to 211K of high-memory. No other memory manager is able to accomplish this feat.

QEMM Shares Memory.

QEMM automatically gives programs any kind of memory they need (i.e. EMS or XMS). Other memory managers require manual *allocation of memory*, which means you have to change your config.sys file and reboot to change memory configurations.

New Feature Highlights

- STEALTH: Maps system ROMs into other areas of memory. Potential memory gain: **211K.**
- NEW OPTIMIZE: Simple menuing interface, "what-if" mode, "view, browse and play" modes, and five new parameters.
- SQUEEZE: Temporarily increases a High-RAM region during a program's loading.
- Support for Suspend-Resume features on laptops.
- Ten new parameters for QEMM386.SYS and LOADHI.COM.
- Support for SCAT shadow RAM.

OUT OF MEMORY

QEMM Practices Safe Memory Management.

Optimize can now automatically detect areas which may present conflicts during operation. Additionally, PS/2 users can sleep well, since QEMM recognizes a wide variety of adapters that may conflict with certain PS/2™ memory areas.

Much More Compatibility.

QEMM-386 can run Windows 3.0 in *any* of its three modes.

Chart data is based on the following: Automat c Memory Gain: DOS 5 will automatically gain up to 76K (using the DOS=h gh and devicehigh commands), QEMM v5 will automatically gain up to 172K (using QEMM's Optimize command and DOS=high), whereas QEMM 6 will gain up to 255K using the new Stealth feature, DOS=high and the new Optimize. As with any utility, these features are dependent on type of machine and application. All trademarks or registered trademarks are property of their respective owners.



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DOS DATA AT WORK

The first BYTE Lab Product Report takes a look at 10 databases for DOS

RICK GREHAN AND STANFORD DIEHL

If this is indeed the information age—and all the signs point in that direction—then you had best make managing information your top priority. In the absence of a unified storage-and-retrieval method, a pile of important facts and figures usually turns out to be just that: a pile. But when you arrange your information systematically, that same data becomes a powerful tool. Enter database management systems (DBMSes), the filing cabinets for the electronic age.

If you dig into the paperwork of virtually any organization worldwide, you probably will come upon stacks of documents whose contents cry out for a digital home in a database: the customer list for the video-rental parlor, the cassette-tape inventory at a busy music store, or even your own company's employee records. Lots of data already has found its way into dBase, Paradox, and other database files, but still more lies locked up in ink.

In this special product roundup, the BYTE Lab examines 10 database packages that can help convert reams of printed material into a useful electronic data bank. Our selections include such well-known packages as dBase IV (a former Ashton-Tate product now marketed and supported by Borland International), Borland's Paradox, Microrim's R:Base, DataEase from DataEase International, Nantucket Software's Clipper, and FoxPro from Fox Software. Other packages include new or lesser-known products that are no less interesting: WindowBase from Software Products International and Alpha Four from Alpha Software. We also look at Informix Software's durable Informix-SQL and Precision Software's Windows offering, Superbase 4.

All of the products we tested run under MS-DOS or Windows 3.0, but our choices by no means represent an exhaustive survey of database packages for the DOS world. Rather, they provide a cross-sectional sampling of packages equipped with similar capabilities (see the features table). We should point out, however, that what you see in the product descriptions isn't necessarily all you can get. In many instances, you can expand the core capabilities of the databases reviewed here by purchasing upgrades such as multiuser modules, C-language interfaces, and fourth-generation programming language add-ons.

The Gauntlet

The primary focus of our testing was to analyze the ease of use and overall capabilities of each database package: How easily can you get data into the package? Is it difficult to construct a data-entry form? How effective a tool is the program's report generator?

To help answer those questions,

BASES

File Cabinets For The Future

we drew up a specification for an inventory system that enables us to put the programs through their paces in a controlled fashion. The specification required importing start-up data into four tables: an orders table, a parts-inventory table, a supplier's table, and a salesperson table. Next, we built an order-entry screen of the type a mail-order distributor might need for its order-entry clerks. For each package, we also created a reorder report and a batch-mode order-entry program for processing orders and comparing them against a salesperson table and parts table.

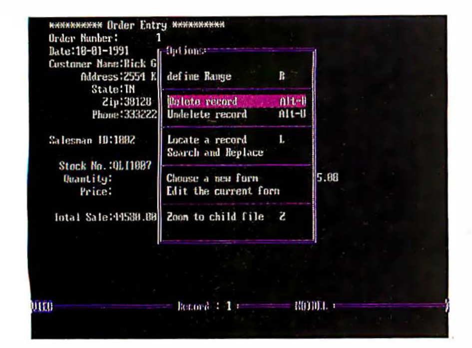
Because raw performance also was a consideration, we ran two timing benchmarks (see the benchmark graphs on page 240). The first measured how long it took each package to index a 4000-item parts file and import that file into the parts table. Although most packages let you create an index before or after reading data into a table, to really put the packages to the test we purposely created the parts table index before reading data in. This method often slows down performance, not only during importation but anytime you subsequently access the index. If you create the index after the table is filled with data, the index tends to be more compact, and searches performed on that index are significantly faster than if you had created the index before importing data.

Our batch order-processing benchmark reads an 800-item order table and posts its orders against a 100-item salesperson table and a 4000-item parts table. This benchmark requires the system to perform searches on the salesperson and parts tables, so we indexed those tables on the proper columns whenever possible.

The packages we tested share a rich set of features. All of them, for example, include some form of browser, a querying screen that permits you to search a database for particular information. Many of these browsers include an edit mode for modifying information in the database. All of the packages also let you create forms and reports. However, each package's methods for supporting standard features is unique; benchmarking a specific group of operations enabled us to uncover these idiosyncrasies.

BYTE ACTION SUMMARY

- **WHAT THEY DO**
  Database packages allow you to store information so that it can be retrieved and manipulated rapidly and in some structured form.
- **WHAT YOU'LL LIKE**
  With most packages you can quickly import your data and easily browse and edit your database once its built. Most DBMSes include a form designer for constructing custom data entry screens and some form of report-builder for generating custom reports.
- **WHAT YOU WON'T LIKE**
  A complex database often requires programming in the database package's DML (database management language), which can be as complex as any high-level language.
- **RECOMMENDATIONS**
  The performance and functionality of FoxPro 2.0 can't be beat. We also liked Paradox for its intuitive interface and outstanding documentation.



ALPHA FOUR 1.1

Alpha Four is a database package that wraps a spiffy, menu-driven interface around a dBase-compatible engine. The advertisements touting it as a "relational database for nonprogrammers" are right on target; Alpha Four lacks a real database management language (DML), so there's not much for a programmer to do. In fact, Alpha Four's programming capabilities are so limited that it couldn't perform our batch order-processing benchmark. (A future release of Alpha Four, however, reportedly will include a powerful scripting language that will make the program more versatile.)

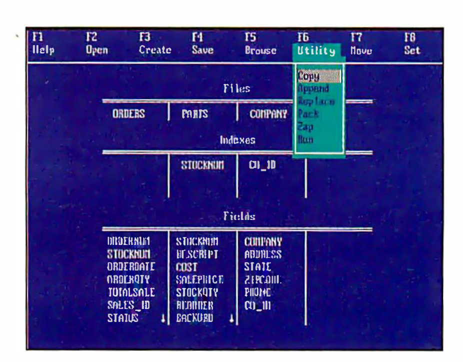
On the bright side, Alpha Four's import capabilities are among the best of any package we tested. If you select the option to import an ASCII file with fixed-length keywords, Alpha Four guides you comfortably through the process of mapping data from the source file to the target database. It even displays the first record of the input file, highlighting sections of the record so you can see instantly what portion of the record you are importing into each field. As you would expect, Alpha Four can read dBase III and dBase III Plus files directly.

You specify relationships among files using the program's set editor (the programs uses *set* to mean *database*). Once in the set editor, you define the primary table (called a *parent database*) and its link fields, its connections to any child databases. The links may be one-to-one or one-to-many, and parent/child relationships may be nested, but you may not create more than 10 databases in each set. The set editor displays links graphically, so you can see a tree diagram of file relationships at a glance.

Alpha Four's forms builder is sufficient for simple data retrieval and querying, but we had trouble using it to do anything complicated. It includes all the basics—multiple file access, verified fields, and calculated fields—but expressions within calculated fields can be only 254 characters long. This restriction quickly limits your ability to set up a form that uses complex decision-making sequences during field updates.

Alpha Four does include some very powerful utilities, though. If you have a search query that you execute frequently, you can save the expression for reuse. If you often use your database to do mailings—creating mailing labels and form letters, for instance—then Alpha Four may be just the ticket. It has functions for just such purposes. Even more useful is Alpha Four's `Post Database` command, which presumes that you keep a database of transactions that you periodically post to a master database. A transaction of this type might be a journal-entries database whose contents you post to your general ledger database on a monthly basis. You tell `Post Database` what the linked field is—the account number, in the previous example—and the command races through the transaction database, tallying its contents into the proper rows of the master database. You can select among four tally functions: add, subtract, replace, or none (although we can't figure out why anyone would conduct a series of null operations on a database).

Alpha Four might be ideal for a small business that uses a database primarily for tracking clients and maintaining an inventory containing several thousand items. The company's claim of providing a package for nonprogrammers is accurate; Alpha Four's ability to easily create mailing labels and churn out form letters attests to that. However, we found the package's simple approach too restrictive overall.



CLIPPER 5.01

Clipper takes the opposite tack from Alpha Four: This database development package is decidedly *for* programmers. Although it lacks some of the nifty code-generation utilities of the other packages, Clipper offers a wealth of tools and capabilities that programmers need.

Two of those tools are a report generator (called RL) and a utility (called DBU) for creating and managing database files, but even these programs come with a twist: They are written in Clipper's own programming language and the source code is included. You can use this code as reference or tweak it and add it to your database applications. You'll especially appreciate the database utility when you're building database structures and objects.

Although Clipper is built for users who understand programming, an interactive working environment still is important, particularly when it comes to doing mundane database management tasks. DBU is helpful here, too. The main DBU screen lists options across the top of the screen, along with the function keys assigned to them. The rest of the screen is devoted to a visual representation of the active database view, which consists of a column split into three sections. The first group displays the names of the active database. If you include an argument when invoking the DBU program, the database or view you specify will appear here. The next section shows the active indexes associated with the active database, and the bottom grouping displays the field names for the active database. The column itself represents a work area. If the column is blank, you simply press the Enter key to see a list of the databases in the current directory. You can select one of them to load into the work area or create a new database by pressing the appropriate function key. This setup lets you quickly and easily load different databases into separate work areas, use or create indexes, and modify the structure of your database. We especially appreciated the ease with which this system let us create different views and set up database relationships.

The RL report generator isn't as flexible. It does not support a WYSIWYG outline of the report, nor does it let you see a preview of the output as you work. The program simply prompts you for a column name and definition. You then type in the field name you want to appear in the first column, along with the title for the column. You also can define summary fields from the column-definition screen. That's it. You can add only one column at a time. After you set up your columns, you can specify groups and set up parameters for the entire report. But even though its procedures aren't slick, RL does the job with ease.

Clipper's real power lies in its coding.

continued

Raima Database Engine Captures Fortune 500 With Record Speed

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Supports: VMS, QNX, ULTRIX, UNIX System V, Berkeley 4.2, AIX, SunOS, SCO, MS DOS, MS Windows, and OS/2. **Most C Compilers and LANs supported.**

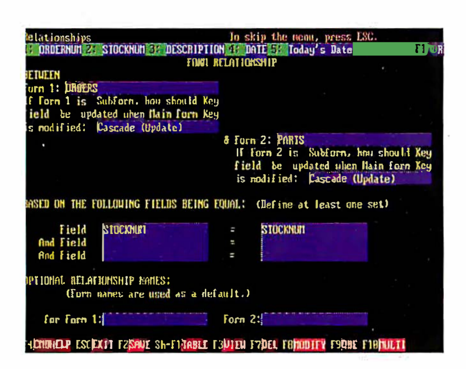
Raima Corporation 3245 146th Place S.E., Bellevue, WA 98007 USA **(206)747-5570** **Fax: (206)747-1991**
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BY112RC

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As the benchmarks indicate, the program's compiler is very fast, but the package also has a number of interesting capabilities. One new feature is its support of so-called code blocks, small chunks of executable code that you can store as variables or pass as arguments to other programs. You use an EVAL() function to execute a code block. Another helpful feature is Clipper's use of make files for tracking which files in a program depend on other files to run properly and keeping them up to date. With this system in place, you can invoke the Make utility to perform only those compiling and linking operations needed to keep all the files in sync. Clipper also supports functions to read from and write to binary DOS files. A file pointer follows the read or write sequence, or you can set the pointer yourself with the SEEK() function.

Programmers also will appreciate Clipper's debugger, which lets you step through your program code, enter commands, and monitor the state of particular variables, field names, or expressions. A status window lists the databases open in all active work areas, as well as the values of all Set commands. The debugger also keeps a history of all routines called as the program code executes. Clipper is not for the database novice, but database programmers will find a lot to like.



DATAEASE 4.2

When you work in DataEase, you get the feeling that the program is taking you by the hand, patiently guiding you along step by step. This can make things easier, but at times you may want to break loose.

If you've worked with databases before, don't expect DataEase to work like anything you're used to. It follows a unique, structured approach. When you start up DataEase, you are greeted with a log-on screen. You must indicate the name of the database you'll work in right off the bat. If you enter the name of a database that isn't listed, DataEase asks if you want to create a new one. The program also prompts you for a user name and password. You can press the Enter key if you don't wish to protect the database from prying eyes.

At the main menu, your choices are listed next to option numbers. You can use cursor keys to highlight an option or press the number of your choice. DataEase does not support a mouse.

Usually, the first thing you do with a new database is create a table (called a *form* in DataEase). DataEase follows this approach but gives you extra mileage. As you create your form, you are creating an entry screen and a table structure. You start with a blank screen on which you can type text (a heading that reads *Company Name:*, for instance). When you press F10 to enter information in a field, a field-entry form containing the text you just typed appears. This sequence is typical of how DataEase works: The interface is made up entirely of menus, function key options, and blanks for you to fill in.

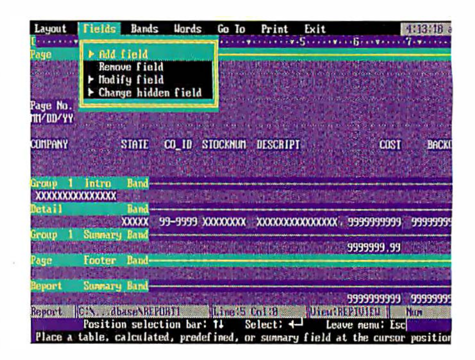
The form used to define your fields exposes some of the powerful features DataEase offers; no programming is required. You can define the field type as you would in any database program, but DataEase also lets you specify numeric formats, such as a phone number or social security number, without using functions or formatting code. You then can designate the field as a required field or a unique field by filling in the blanks the program presents. An entry labeled *derivation formula* lets you enter a formula for the field, such as *quantity*price*; you can use the resulting figure to compute the value in the total sales field.

After you design your forms, you can link them using another menu option. You simply specify the forms you want to link and fill in the fields to link; DataEase makes sure the connection is retained during all subsequent operations. For instance, you can pull up a primary form that tracks company names and press F10 to access a secondary form listing the parts a particular company supplies. DataEase keeps track of the relationship between the two tables.

DataEase's structure made it especially easy to generate our report. We designated a primary table to use and a form came up with the field names. Next, we pressed the space bar to select the fields we wanted to show up on the report. DataEase also let us enter keywords in the field list so that we could group selected fields or accumulate statistical information such as running totals. This enabled us to call up a related table or, easier still, create a lookup field for pulling the associated information into the report. For the company field, for instance, we entered the keywords *group* and *sum* and designated part numbers as the lookup field. This produced a report listing each company name and the part number of the products the parts table indicated that the company supplied. The total replacement cost for all back-ordered parts from each company was listed at the end of each company's parts list, and a grand total was supplied automatically at the end of the report.

The program is easy to work with, but in the end we felt confined by DataEase's environment. You must use the DataEase editor to build code, and it won't let you save a file that contains bad code or nonexistent variables. We also had problems with the batch-entry code because we started out using lookup fields. DataEase's lookup fields are updated only when you enter data in a form; they do not change when the data referenced by the lookup changes. This limits their usefulness for programming purposes.

Restrictions such as this won't help programmers feel comfortable in the DataEase environment, but novice users who need to set up their own applications should do well with the package.



DBASE IV 1.1

Gone are the days when dBase set the standards for DOS-based database management. dBase rose to the top mostly on the strength of its powerful programming language. Delays and buggy releases opened the door for packages that included the same programming prowess hidden beneath simpler interfaces.

dBase is becoming easier to use: In addition to the dot prompt so familiar to old-time dBase hackers, the program now offers a menu-driven interface called the Control Center. Although the Control Center represents an improvement for users intimidated by a single

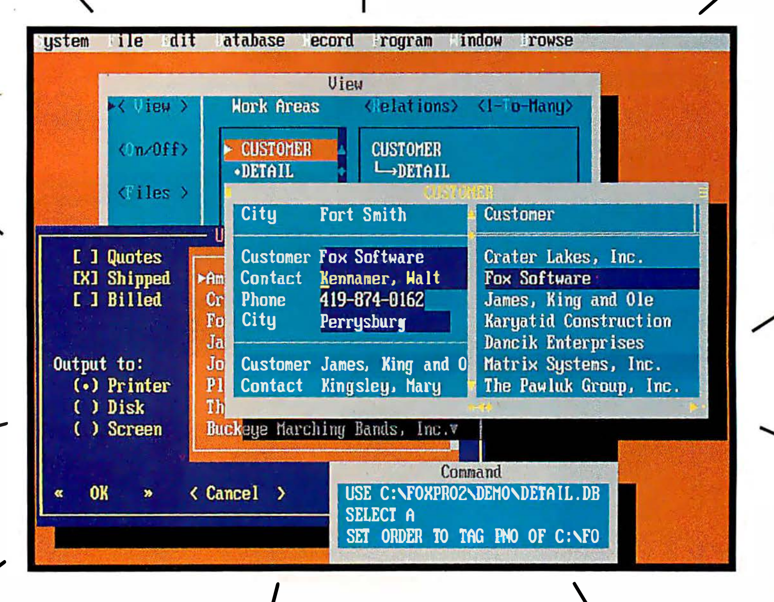
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For users, the View window makes it easy to work with multiple tables of data, RQBE (Relational Query By Example) simplifies the creation of business queries.

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FoxPro 2.0 runs your industry-standard dBASE programs today, lets you build on your current systems for your needs tomorrow.

Optional Distribution Kit creates stand-alone .EXE files for distributing your applications.

Application Program Interface (API) links to external libraries written in C or assembler. Third-parties are currently developing communications, client/server access and other packages. (Optional Library Construction Kit available.)

Applications you write in FoxPro 2.0 can exchange data with our FoxBASE+/Mac on a LAN today, will run virtually unchanged under our Windows, Mac and UNIX versions currently in development (no release date yet).

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And that's the problem: the response has been overwhelming.

We're hearing of callers being on hold for 20 minutes or longer!

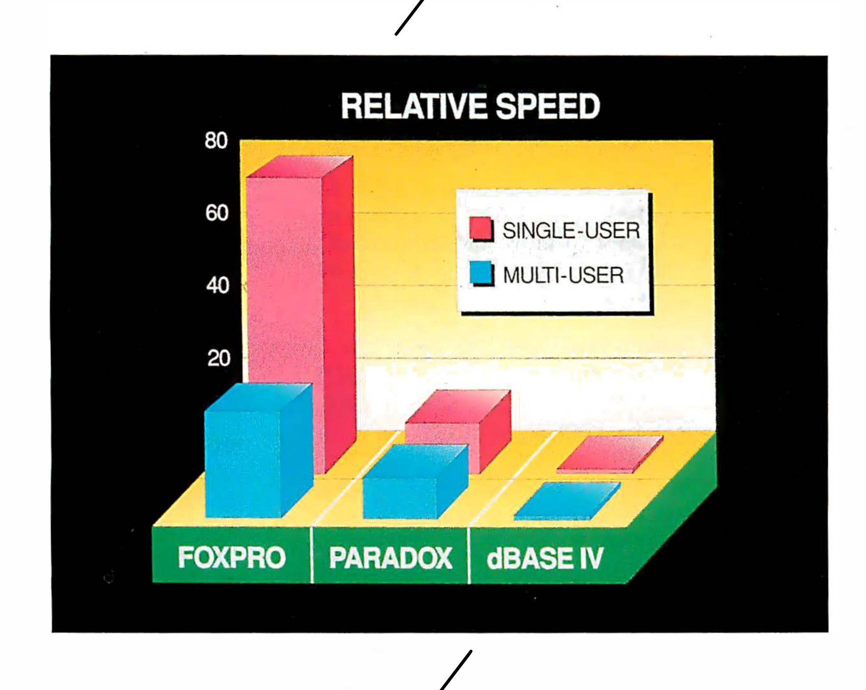
And this in spite of ramping up our support months in advance of the release.

Well, we're adding another 40 phone lines and hiring more people. And if that's not enough, we'll add even more.

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we'd be apologizing database in the world.

Results from an extensive suite of query tests independently performed by Micro Endeavors, Inc. and published in the 8/91 issue of Data Based Advisor.



FoxPro 2.0 is far faster than the other PC database management systems and raw compilers like Clipper, both single-user and on a LAN.

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Call 1-800-837-FOX2 or 419-874-0162 again. (We believe we've fixed it.)



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dot on a blank screen, the simple addition of pull-down menus doesn't make this a user-friendly product. First of all, the package doesn't offer mouse support. You must rely on Alt-key combinations, cursor keys, and function keys to get around. The Control Center doesn't help the cause much by requiring confirmation whenever you move out of one operation and into another. Even when you've saved the data in the window and you press the Escape key to return to the main menu, the Control Center asks if you really want to do that.

Once you get used to the key sequences, the Control Center offers a few nice features. Among them is the program's query builder. As with many other packages, you start out with a skeleton of the active database structure. You can add multiple databases to the query from the menu and switch among these databases with function keys. By pointing to field names in the skeleton, you can create links between databases, specify fields to include in the query, organize the database using specific fields and sort methods, and set the conditions for the query. A query also can trigger multiple-record updates; you can save the result as a view or as a new database.

We really missed mouse support when building forms and reports. Worse, the interface offers no obvious way to relocate text and fields. You won't find cut-and-paste capability (not even in the editor), and you can't simply select a field and move it. After consulting the menu and the documentation, we finally resorted to deleting fields and replacing them. The forms generator did not support multiple database entry forms without some tweaking of the code. When we first loaded different databases from the menu and placed the fields on the design screen this looked possible, but when we ran the form, it could not find the field designators. We loaded all the databases used in the form into different work spaces and set up relationships for each of them, but the form still didn't understand any references for fields outside of the active work space. Fortunately, the fix was simple. We loaded the generated code (saved with a .FMT extension) into an editor and prefaced the external field names with the databases they belonged to. Not a huge undertaking, but the form generator should have been able to do it.

Usually, the best way to work with multiple databases is to create a query first. This worked well with the report generator but was less effective with the form generator. We couldn't use the dBase form templates for operations that allow updates (browse and edit, for instance). The view created was set to read only. To create our report, we set up a query and used the result to design the report. That worked and didn't require additional tweaking. We added a group designation and placed the company name in the group header so that the company name was listed first, followed by all the part numbers for that company. We then moved to the end of the highlighted band below the group and added a summary variable to compute the back-order replacement cost. This gave us a cost summary at the end of every group listing. The report generator automatically set up report summaries for all our numeric fields. We deleted those we didn't want to use.

Because of the state of the documentation we received, however, the process did not go as smoothly as it sounds. While we were reading about update queries, the discussion suddenly switched to forms. Finally, we discovered that the manual had jumped from page 8-6 to page 9-19. We started looking around for the last part of the chapter on update queries and noticed that chapter 10 also ended abruptly, cut off once more by page 9-19. The rest of the pages then fell in order, but we didn't find the last part of chapter 8 until we rustled up

A Taste of SQL

Two of the database packages we worked with—Informix and WindowBase—used SQL as their database management language. Another, R:Base, retains SQL compatibility while adding a few other capabilities.

To work effectively in any SQL database, you need to start by placing yourself in a "table" frame of mind. That involves adjusting to the idea that you have to manipulate your database as a whole, rather than as a collection of individual records. At times, this approach offers distinct benefits. For example, when we imported the salesperson information into the SALESPERSON table in Informix, we noticed that we had set the ID field incorrectly. It should have ranged from 1000 to 1099 but instead ranged from 0 to 99. In a database not based on SQL, fixing the problem might have required writing a looping structure to read in each entry, changing the ID number, and writing the change back to the database. In SQL, the solution is as simple as adding 1000 to each ID number. The statement to do this is:

```
UPDATE SALESPERSON SET ID =
ID + 1000.
```

But because SQL implementations are far from standardized, not all structures are as predictable across the board. In Informix-SQL, for example, we used the following sequence to move the contents of a field from the parts table into our orders table:

```
UPDATE ORDERS SET PRICE =
    ( SELECT PRICE FROM PARTS
     WHERE ORDER.STOCK_NO =
PARTS.STOCK_NO);
```

WindowBase's SQL, however, does not permit an embedded SELECT command within the SET clause of an UPDATE statement. To combine fields from two tables, you must create a third table and link them along a common field. To complete the operation described above, for instance, you would create a temporary orders table and issue an INSERT command with an embedded SELECT command. The SELECT command would include all the fields from the first orders table, along with the price field from the parts table. The WHERE clause would look similar to the one above and would specify the join field (STOCK_NO, in this case):

```
INSERT TEMPORDS
    SELECT <fields from ORDERS>,
PRICE
    FROM ORDERS, PARTS
    WHERE ORDER.STOCK_NO =
PARTS.STOCK_NO
```

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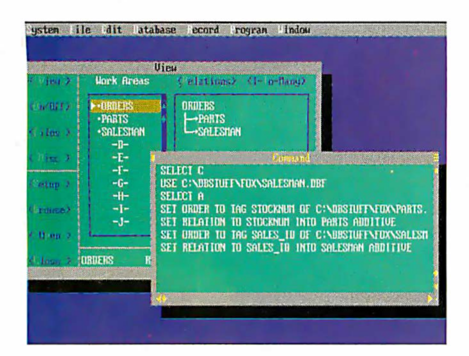
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another dBase package from the BYTE library. Hopefully, quality control will improve under Borland.

The latest release of dBase IV is an improvement over past incarnations. Still, if you like the power and maturity of the dBase language, FoxPro is the better product.



FOXPRO 2.0

If your primary criterion for a database is performance, you need look no further than FoxPro 2.0. But that's not its only selling point. FoxPro has a lot to offer casual users and developers alike. The interface includes pull-down menus—along with a convenient command window—so you can use menus or type commands without either interface getting in the way of the other. Mouse support is the best of any character-based package we've worked with. The command window keeps a running history of FoxPro instructions. This makes it easy to repeat commands used throughout a session. You also can select portions of the command history and paste them into your applications. If you trigger operations from the menu options, FoxPro places those instructions in the command history—a great tool for building applications. You can perform an operation using FoxPro's menus, capture instructions from the command history, and paste them into a program file.

FoxPro made child's play of our project. To create the data-entry screen, we opened the databases and set up the necessary relationships. FoxPro's View Window assisted these setup chores. The window graphically depicts available work areas; you can select a work area and open a database in it by clicking on a command button. FoxPro provides a list of databases from which to choose. After loading the three databases we needed, we highlighted the orders database and selected the command button to set a relationship between it and the parts database. FoxPro offered a dialog box with a list of key fields. We selected the stock number field to link the two databases. Because we would need to repeat this operation later when writing code for the batch-order test, we called up the command window, copied the commands generated in the operation, and pasted them into a program file.

When we designed the input screen, the screen generator saved environment information. We didn't have to worry about opening databases first and setting up the relationships. The screen builder starts off as a blank screen in which you can enter text and place fields. You also can create command buttons, check boxes, "radio" buttons, and pop-up lists. And you can attach pieces of code to any object, including the fields. From the setup screen, you can designate code to run before and after the screen-entry program. When you generate code for the screen you've designed, you can attach other screens to it, which saves you time once you build a library of generic screens. We simply added a control screen included in the tutorial for navigating through records, adding a command button for processing an entry and attaching code to update the parts database and the salesperson database each time an order is entered.

The easiest way to create the reorder report was to build a query first. To do this, we opened a new query screen and selected the company database and the parts database for our query. A dialog box, which included three blank boxes, prompted us to enter the linking criteria. Clicking on the box on the right brought up a list of fields in the parts database, while the left box offered fields from the company database. The middle box provided a choice of relational operators (like, less than, and so on). With a few clicks of the mouse, we had created a simple query. Next, we selected the fields we wanted to include, grouped the query by company name, and sent the result to a report. When we ran the query, FoxPro generated a report file, which we could call up from the report builder for reformatting. As in the screen builder, we could drag text and fields around with the mouse or group information and then move it. To keep track of running totals, we defined a couple of variables and put them in the group footer and the page footer. A query is saved as a program file and since a formatted report is part of the query, you can generate the final output directly from the command line by invoking the DO command and using the filename as an argument, or you can include the command sequence in an application.

FoxPro was a barn burner on our performance tests, thanks mainly to FoxPro's proprietary Rushmore technology. Our one complaint about the package is its unwieldy documentation. Finding information quickly was a problem, but a strong on-line help facility got us through the rough spots. FoxPro is simply an outstanding product.

```
RDSQL:  New  Run  Modify  Use-editor  Output  Choose  Save  Info  Drop  Exit
Run the current RDSQL statements.

-- 1 to 19 of 144 ----- INVENT ---------------- Press F1 for Help ----------

database invent;

create temp table tsales
  ( salesman_id smallint,
    quantity integer,
    sale_price money,
    total money);

insert into tsales
  ( salesman_id, quantity, sale_price )
  select salesman_id, quantity, sale_price
  from torders;

create index tsidx on tsales (salesman_id);

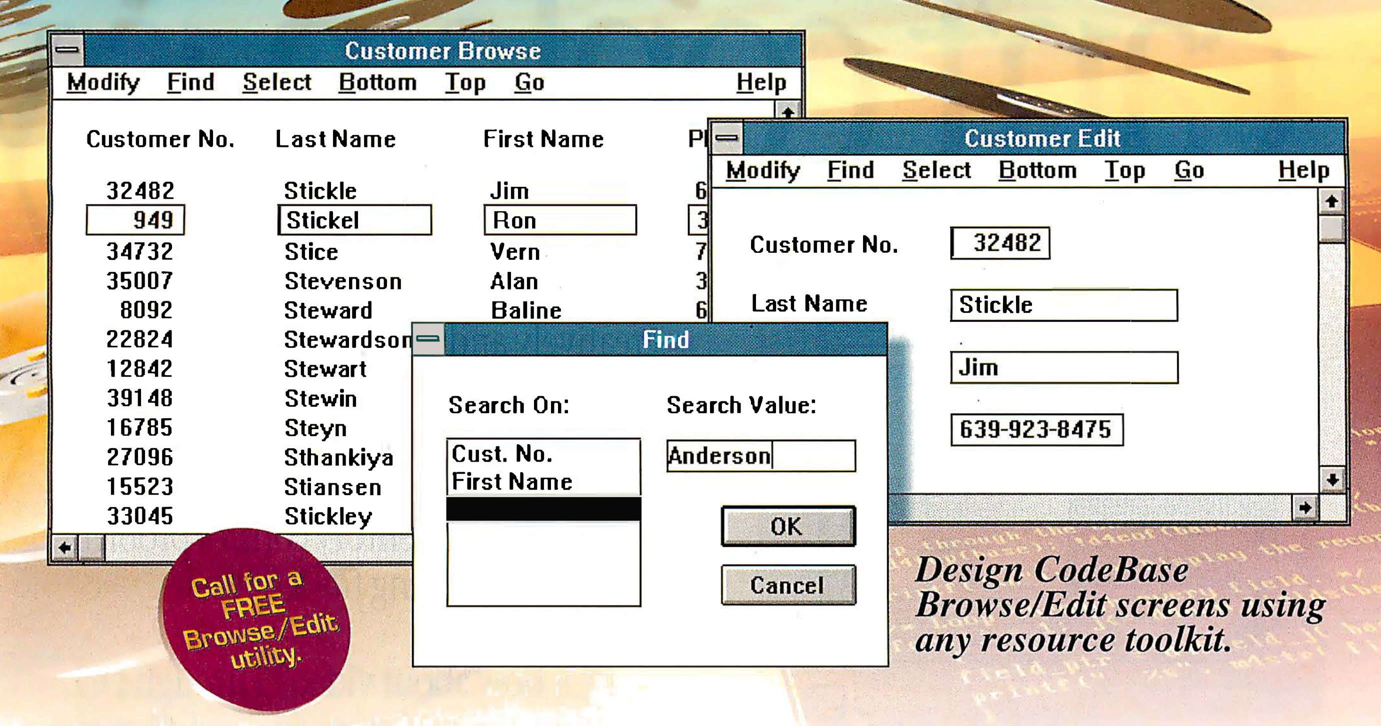
update tsales
  set total = quantity * sale_price;
```

INFORMIX-SQL

Informix-SQL is a structured-query-language (SQL) database through and through. The program's look is more Spartan than that of the other systems we examined; you'll find no multicolored screens with pop-up menus and windows here. The package's Lotus-style, menu-driven screens automate the more significant database operations, such as creating a table, defining and altering fields, and so on. Informix also includes a report generator and a system for executing form-definition files that you design and write in a kind of pseudolanguage. But at its core, Informix is a SQL system.

You build a form in Informix, not by moving a cursor about on the screen with a mouse or arrow keys, but by writing a *form-specification file*, a kind of screen definition coupled with executable instructions. This file comprises five parts: a database section, which identifies the database on which the form will operate; a screen section, which defines the layout of the screen; a tables section, which identifies which tables the form will access; an attributes section, which describes each field displayed by the form; and an optional instructions section, which defines operations to be performed on fields within the form. Simply put, the database and tables sections tell the system what to show, the screen section tells where to show it, the attributes section tells how

Access dBASE IV and FoxPro files from C or C++



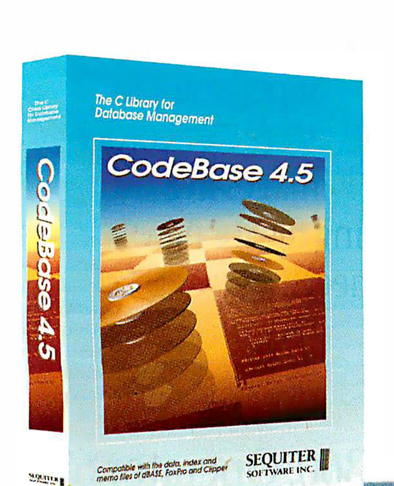
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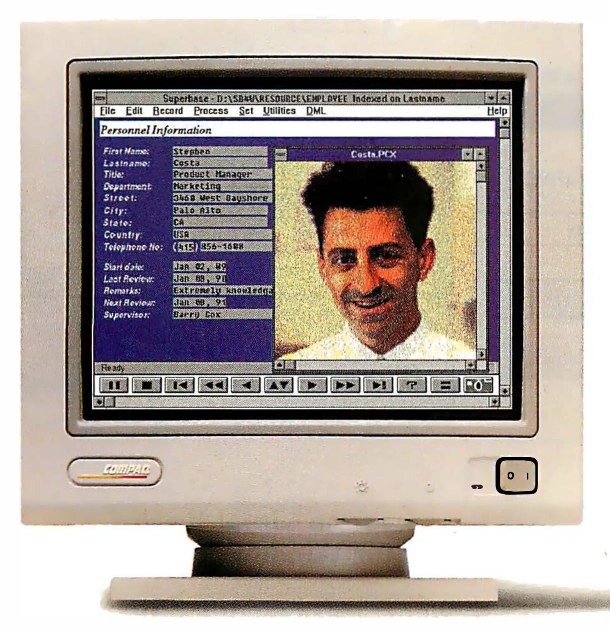
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to show it, and the instructions section tells the system what to do before, during, and after showing it.

There's a catch to Informix's form system, though: You can operate only on fields displayed by the form. This ran us aground when we were building our order-entry form. Each order carried a salesperson ID number, which referenced a row in our salesperson table. We naturally wanted the appropriate salesperson's year-to-date sales field updated whenever an order is committed. But we didn't want to let an order-entry clerk see a salesperson's year-to-date sales, so we tried to update that field without displaying it. No chance. Another annoying shortcoming is how fast error messages come and go. In most cases, they appear on the last line of the screen, heralded by a beep. If you don't get your eyes down there quickly enough, the message is gone before you've read it. This happened twice while we were trying to create an index for one of our tables. Ultimately, we did get the index built, but to this day we don't know what the error was.

Included with Informix-SQL are a number of utility packages. BCHECK verifies the integrity of indexes; if it finds a discrepancy between a data file and one of its indexes, it lets you recreate the index. DBLINK and DBLOAD are handy for ferrying data between Informix and the outside world of Lotus 1-2-3, dBase, or ASCII files. With DBSCHEMA, you can produce the SQL statements needed to create a table or database (if you've already built the table in Informix).

The Informix-SQL documentation is well presented, and the software certainly is solidly crafted. Informix-SQL runs on a variety of platforms; if you're interested in portability this is a DBMS to consider. In addition, Informix sells numerous add-ons that extend the capabilities of Informix-SQL. One such package, ESQL, lets you embed SQL in C programs so that you can write code to more efficiently perform operations that SQL is ill equipped to handle.

View Ask Report Create Modify Image Forms Tools Scripts Help Exit
View a table.

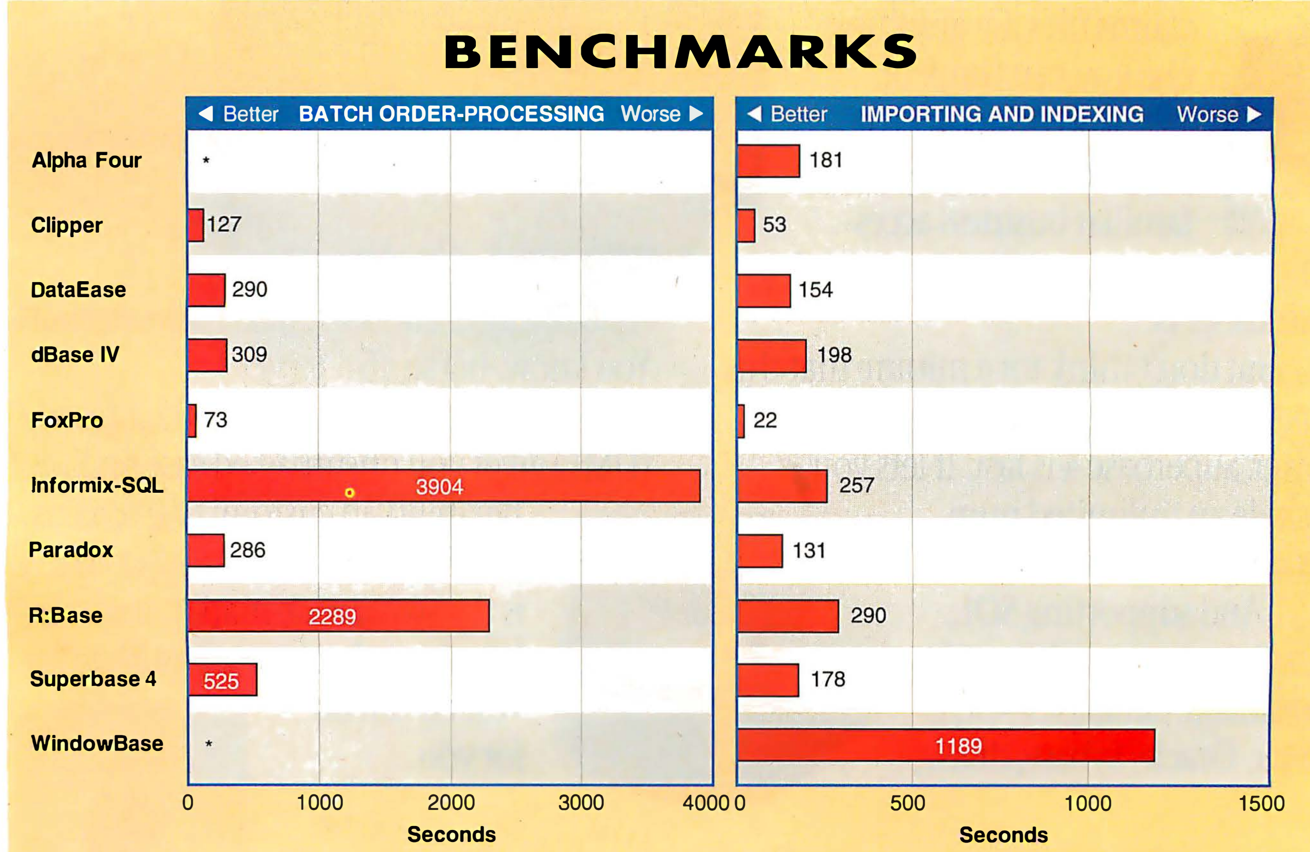
SALESMAN	ID	NAME	YTD_SALES
1	1000	Prosper	0.00
2	1001	Jones	15,206,818.00
3	1002	Delivered	1,816,088.00
4	1003	Optimal	21,929,490.00
5	1004	Jones	41,472,864.00
6	1005	Hitless	39,999,950.00
7	1006	Bonzer	19,665,855.00
8	1007	Ostracize	3,059,000.00
9	1008	Moneybag	30,746,120.00
10	1009	Commonwealth	2,977,203.00

1	1	DEH3766	12/04/91	2004	1013
2	1	VLN2268	12/19/91	3595	1065
3	2	BYX2698	12/09/91	2476	1087
4	3	RJL2403	12/14/91	4289	1073
5	4	HHE1269	12/26/91	4821	1080
6	5	DXP2906	12/15/91	3550	1000
7	6	WRO3969	12/17/91	4200	1049
8	7	CXW3862	12/24/91	2081	1045
9	8	CNN2537	12/11/91	2862	1011

PARADOX 3.5

One of Paradox's most notable characteristics is its speed. Not only did Paradox perform well in our speed tests, its response time for browsing and editing tables was quick-as-a-blink fast.

You do complex querying and editing using the query by example (QBE) technique. It works like this: Paradox presents you with a grid that mimics the layout of the target database. You enter



For the Importing and Indexing benchmark, each program had to create a 4000-record database of parts information from an ASCII file. The Batch Order-Processing benchmark tests the time it took each package to post a batch of 800 orders and update three separate database files. In each case, FoxPro displayed the most impressive performance.

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relational operations and filters within the fields you want Paradox to evaluate. For example, if you want to set all current sales figures to zero, you would type >0, CHANGETO 0 in the appropriate field slot in the template. When you turn Paradox loose, it uses the information in the template to guide its actions.

Paradox supports the most important import and export formats, but we ran into trouble importing information stored in ASCII format. During the portion of our testing involving importation of ASCII data, Paradox demanded that the fields for each record of the import file be arranged in the same order as the fields in the destination table. (In contrast, Alpha Four allowed us to map input fields to target fields in the database.)

With Paradox, you must plan carefully before jumping into building a form. This is particularly true with forms that access multiple tables. Multitable form design involves creating a master form for the master table, then inserting into that master form embedded forms from other tables. So to create the full master form you should design your embedded forms first—unless you don't mind flipping back and forth among forms as you work. Upfront design will eliminate lots of down-the-road headaches.

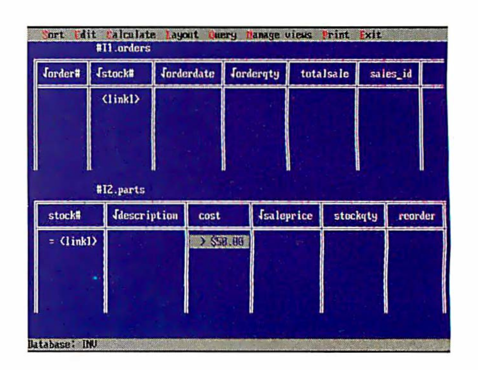
Paradox's database management language is PAL, though to present PAL as simply a DML is a misrepresentation. PAL is not what we expected. Being a procedural language, PAL is not a SQL derivative. Nor does its repertoire include typical database manipulation language statements such as SEEK_KEY and READ_RECORD and DELETE_RECORD. Rather, PAL is a language that automates the Paradox environment. For example, the PAL command for moving to the next record in a file is DOWN, which simulates the effect of pressing the down-arrow key (hence the command's name).

What makes PAL programming difficult is that it resembles sending commands to a robot that's sitting at a keyboard running Paradox. For example, the DOWN command moves to the next record if you are viewing a table. However, if you are in a form (and you can execute forms from within PAL), the DOWN command moves the cursor to the next entry field on the form. A command reacts differently in different states of the Paradox environment, and Paradox has many different states. The key to effective PAL programming, then, is to thoroughly learn Paradox's menus and keyboard and form designer before you try to do any serious work with PAL. The rewards will be well worth the investment in time.

If, however, you simply don't want to have anything to do with PAL, you can install the Personal Programmer. Essentially an application builder, this program guides you through creating an application—complete with menus and forms—outputting PAL code as its final product.

The people who wrote the documentation explaining all of Paradox's ins and outs had better be getting paid well, because they're doing a bang-up job. Borland is fast gaining a reputation for supplying good manuals with its software, and the documentation that accompanies Paradox only bolsters that reputation. Each manual is a supermarket of illustrated examples, each heading on a page is highlighted with a light blue bar, and Borland even put small blue arrows under the page numbers to help you quickly get your bearings as you search for a particular page number. Well done, indeed. The quality of Paradox's documentation alone earns it a high place among this roundup of database packages.

Finally, we should mention the raft of Paradox add-ons that Borland supplies: SQL Link allows you to embed SQL queries in PAL code and talk to SQL servers, the Paradox Engine provides low-level C and Pascal access to Paradox tables (see "Database Building Blocks" on page 204), and Paradox Runtime lets you build applications and distribute them to clients who don't own Paradox.



R:BASE 3.1

When you start up R:Base, a command bar appears across the top of the screen. You can use a mouse or Alt key combinations to make selections that bring up a series of pull-down menus. But because the package's mouse support is a bit uneven, we often resorted to the keyboard. Worse, R:Base does not

COMPANY INFORMATION

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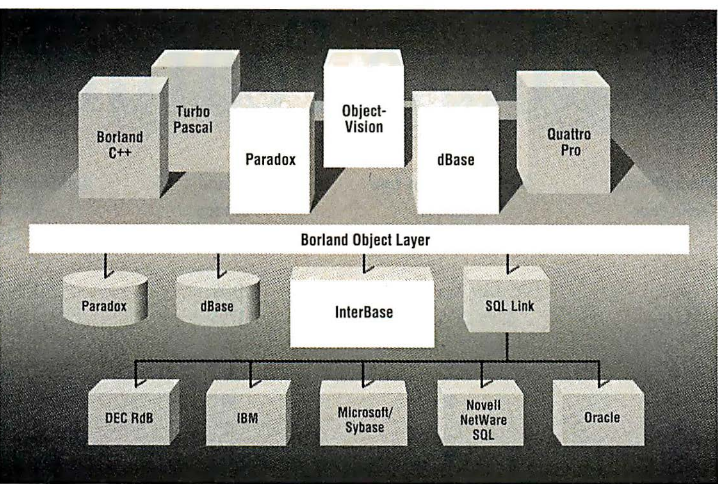
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*1991 J.D. Power and Associates' Computer End User Satisfaction Study: Phase I. Office-Based Small to Medium-sized Businesses.℠ Response from Business End Users at 1,784 business sites. Small to medium-sized businesses were based on office sites with between 1 and 499 employees. 1991 J.D. Power and Associates' Computer End User Satisfaction Study: Phase III: Office-Based Large Businesses.℠ Responses from Business End Users at 1,094 business sites. Large businesses were based on office sites with 500 or more employees. J.D. Power and Associates is a service mark of J.D. Power and Associates. †Dealer prices may vary. Upgrade pricing good in U.S. and Canada only. Borland is a registered trademark of Borland International, Inc.

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Database Features

Company Product Version	Alpha Software Alpha Four 1.1	Borland/Ashton-Tate dBase IV 1.1	Borland Paradox 3.5	DataEase International DataEase 4.2	Fox Software FoxPro 2.0
Platform(s)	DOS	DOS, Unix, Mac, VAX/VMS	DOS	DOS, OS/2	DOS
Price	$549	$795 (DOS version)	$795	$795	$795
Field Types					
Integer	●	○	●	●	●
Floating Point	○	●	●	●	●
Currency	●	○	●	●	●
Date	●	●	●	●	●
Time	○	○	○	●	○
Text	●	●	●	●	●
Variable Length (memo)	●	●	○	○	●
Other	Logical	Numeric	○	Fixed-length memo	Logical
Import Formats					
ASCII	●	●	●	●	●
DIF	●	●	●	●	●
DBF	●	●	●	●	●
SDF	○	●	○	●	●
SYLK	●	●	○	●	●
WK1	●	●	●	●	●
Other	PFS, WordPerfect merge	FWII, RPD	Quattro Pro, Reflex	Custom	Paradox
Query Language					
dBase	●	●	○	○	●
SQL	○	●	○	●	Partial implementation
Proprietary	●	○	● (QBE)	●	○
Recommended Capacity					
RAM	640 KB	640 KB	640 KB	570 KB	640 KB rec., 1.5 MB XMS
Disk	2.0 MB	5 MB	3-4 KB	2.5 MB	6 MB
Limits					
Maximum # of Open Tables	10	10	24	255	99
Maximum # of Indexes per Table	7	57	1 per field	255	unlimited
Maximum Rows per Table	2 billion	1 billion	256 million	255	1 billion
Maximum Fields per Row	254	255	255	255	255
Maximum Record Size	4000 bytes	4000 bytes	4000 bytes, indexed	4096 bytes	4000 bytes
Password Security					
User	○	●	●	●	●
Database	○	●	●	●	●
Table	○	●	●	●	●
Access Levels	r/w	●	●	●	●
Encryption	○	●	●	●	●
Multiuser Support					
File/Table Locking	○	●	●	●	●
Record Locking	○	●	●	●	●
Tools					
Form Generator	●	●	●	●	●
Report Generator	●	●	●	●	●
Database Language	○	●	●	●	●

employ scroll bars, so you'll have a hard time navigating with the mouse, especially when you're building a report that is wider than the screen. You'll also wish you could move fields around by clicking and dragging the mouse while designing forms and reports.

The first pull-down menu lists the databases available to you; you simply select the one you want. If you have dBase files, you can open them from this menu—along with indexes—without importing or converting them. After you select a database, another pull-down menu lists the tables associated with the

Informix Informix-SQL 2.10.06	Microrim R:Base 3.10	Nantucket Clipper 5.01	Software Products WindowBase 1.0	SPC Superbase 4 1.3
DOS, OS/2, Unix $795	DOS, OS/2 $795	DOS $795	Windows 3.0	DOS/Windows $695
●	●	●	●	●
●	●	●	●	●
●	●	○	●	●
●	●	●	●	●
○	●	○	●	●
●	●	●	●	●
○	●	●	●	●
Decimal, serial	Numeric	Logical	Boolean, datetime, image	External text or graphics, logical
●	●	●	●	●
○	●	○	●	●
○	●	●	○	●
○	○	●	○	○
○	●	○	○	○
○	●	○	○	●
○	PFS	●		WKS, XLS, LGS, SOL, SBF
○	○	●	○	○
●	●	○	●	○
	○	○		●
640 KB real/1 MB prot.	640 KB	300 KB	2 MB	2 MB
3 MB	6 MB	3.5 MB	2 MB	1.5 MB
unlimited	80	250	8	unlimited
unlimited	unlimited	15	999	unlimited
unlimited	unlimited	1 billion	2 billion	1 billion
unlimited	400	1000	255	unlimited
32,768 bytes	4096 bytes	65,534 bytes	2 billion bytes	unlimited
●	●	○	●	○
○	●	○	●	○
○	●	○	○	●
●	●	○	n/a	●
○	●	○	●	○
●	●	●	n/a	●
●	○	●	n/a	●
●	●	○	●	●
●	●	●	●	●
●	●	●	●	●

● = yes ○ = no n/a = not applicable

active database. Selecting a table puts you in browse mode, from which you can view or edit your data. Other options within the table menu let you modify the structure of tables and create new tables. All the elements of a database—reports, forms, and views—are available from the main menu.

To build a query, you work from the browse-mode menu. The query screen displays the column names of the selected table; you can select the columns you want to include in the query and set conditions by specifying them below the column name. Another menu selection lets you include up to five other tables in the query and link them by columns. This provides an easy way to build powerful queries, and you can view the results in browse mode or save the result as a separate table or as a view file.

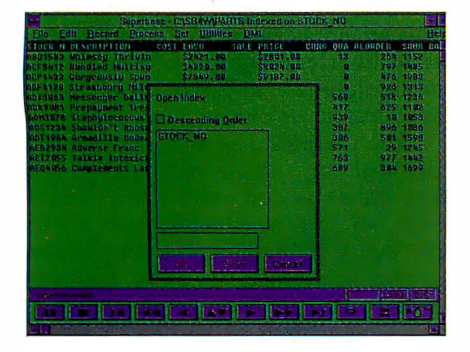
You can create an R:Base command file with any ASCII editor. The code you create is compatible with ANSI SQL, so SQL programmers should be productive right away. The applications generator is especially slick, allowing even nonprogrammers to create menu-based applications without a hitch. Experienced programmers can cut their programming time by generating an application automatically and customizing the resulting code.

We did run into some trouble building input forms, however. Normally, R:Base lets you refer to inactive tables by prefacing the column name with the table name (as in `company_table.company_id`). Unfortunately, the form builder does not support this type of reference. You can include multiple tables in a form, but only one form may be active at a time, and you can't refer to the columns of an inactive table. Fortunately, other features make this an easy limitation to get around. We set up our form with only one active table and used variables to look up related data in the other tables. When you do this, you may attach a command file to any field so that you can validate entries or process input—to exclude parts that cost more than $40, for instance.

The report builder easily handled our sample report. We started with a quick report that automatically displayed selected columns from our parts table on the screen. We then defined lookup variables to pull the name and address of the company supplying each part. By defining the company ID number as a break point, we got R:Base to automatically sort on that number. A variable in the break footer summed the replacement cost of back-ordered parts for each company. We also placed a variable in the report footer to return a grand total for the entire report.

R:Base's biggest drawback is its slow performance. It lacks a facility to automatically link tables together; instead, you must manually set up a pointer (called a *cursor*) and then update tables by matching a key field. For this reason, R:Base does not process batch orders very quickly.

Still, R:Base is a good choice for non-programmers. Its interface is intuitive and easy to learn, and its applications generator really works, churning out useful code from simple specifications.



SUPERBASE 4 1.3

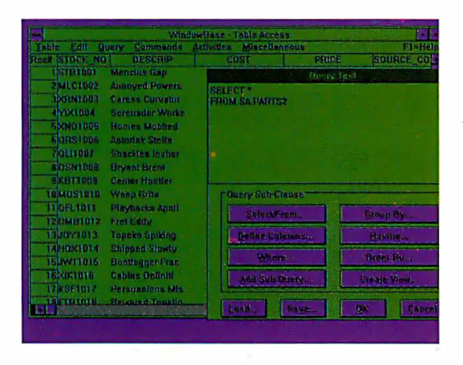
Built to run under Windows 3.0, Superbase 4 is a database package with some quirky but clever features. The quirk you'll notice first is the list of controls at the bottom of the program's main browsing screen. You'll think you're looking at the front panel of a tape deck: There's a rewind button, a fast-forward button, and even a pause button. The tape-deck paradigm fits neatly into database browsing. Once you enter a search criteria and skip to the target record, you can hit Fast-forward to step rapidly through the succeeding records. Hit Pause to stop on a record you're interested in, or rewind if you passed it.

Because it has dynamic data exchange capabilities built in, Superbase 4 can act as a DDE server or a DDE client. This lets you, for example, link Microsoft Excel and Superbase 4 so that data retrieved from a Superbase 4 data file is inserted into the cells of an Excel spreadsheet.

Working with Superbase 4's form designer is almost like using a paint package. When you open a blank form, a toolbox of icons appears across the bottom of the screen. From the toolbox, you select the kinds of objects to place on the form: fields, calculations, boxes, even imported images. The system uses an intelligent hierarchy for displaying objects to govern what happens if you try to place one object on top of the other: Fields are displayed on the top, then text, then images, and so on. Another nice feature is that the designer lets you embed commands within forms. The commands remain invisible, jumping into action only when they detect the right type of input.

Superbase 4's programming language, DML, is based on BASIC. Luckily, it's sufficiently structured—it includes `IF...THEN...ELSE` and `CASE` statements—and uses labels rather than line numbers. Writing programs in DML is straightforward. Superbase 4 supplies a simple editor (it will sustain life, but that's about it). You can load and save ASCII files if you prefer to construct your DML programs in another editor. You also can enter single lines (each line may contain as many as 255 characters) of DML commands from a pull-down menu, which lets you use DML to take shortcuts. For example, if you want to clear out a database named Orders, you can open the command line window and type `REMOVE FROM FILE "ORDERS"`.

In addition, you can use Superbase 4's DML to create start-up programs that execute when you fire up Superbase 4. Other helpful features include macros, a built-in communications package you can use to send files from machine to machine, file viewing of external text or graphics files, and a LAN version with extensions to the DML for multiuser programming. In short, an abundance of features like these and good performance put Superbase 4 near the top of its database class.



WINDOWBASE 1.0

Like Superbase 4, WindowBase is designed to run under Windows 3.0, but although both are graphically oriented they neither look alike nor run alike.

One of WindowBase's many importation selections lets you specify that the field types in the first record are stored in the first record of the import file. WindowBase reads the first record and "guesses" at the format of the remainder of the file based on the contents of the first record's fields. You can help it by specifying the field names and their proper types before WindowBase proceeds with the rest of the file. This technique made it easy to import our sample data. That's good, because the rest of the importation process was slow. Just importing into an index-free table took over 17 minutes for the 4000-item parts file. We watched impatiently as a counter displaying the percentage of completion inched its way upward. When the counter reached 100 percent, we were only halfway to being finished. After telling us it was done, WindowBase pounded the disk for at least 8 or 9 minutes before returning cursor control. Speed is definitely not the hallmark of this package. Once we built the parts table, opening it took nearly a minute and a half. Perhaps WindowBase was reading as much as it could into memory so things would run faster.

As you would expect, WindowBase's form designer is graphical. Object icons appear across the top of the form-design window; tool icons line up across the bottom. You can import graphic images and embed them into your forms.

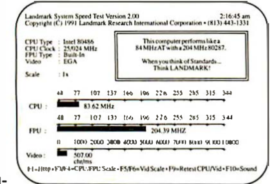
Designing a form with WindowBase requires some patience and lots of SQL know-how, since SQL is the underpinning for the form designer. Every form has a governing SQL query (typically, a `SELECT` statement) that specifies the tables covered by the form. Fields in which data is entered or displayed are referred to as cells. The cells within a form may be controlled by the governing SQL statement, or have their own "dependent" SQL query (called dependent because it is contingent on a value stored in another cell). The information stored in a cell may be data or the result of a calculation. Furthermore, you can use a calculated cell to update a column within a table. WindowBase provides a function called `external()` that lets you pull data in from a table outside the form and enter that data into the current table.

You also may need a bit of patience with the WindowBase documentation. Once, while we were updating the parts table to clear the back-order amounts, we got an "internal error -120" error message. We searched the manual for an error appendix but came back empty handed. A call to the company's technical support line revealed that we had uncovered a bug; the solution was to put an exclusive lock on the table. Unfortunately, this required using a command that was not in the manual, either. The technical representative we spoke with assured us that the next release would include the correction and the new command.

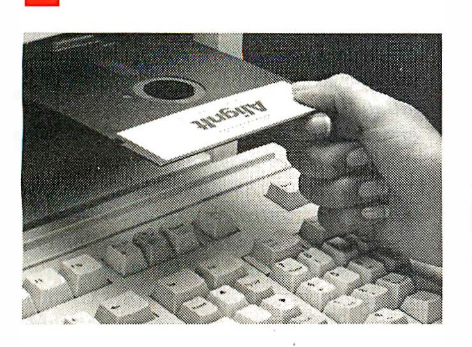
Other deficiencies in the manual caused more problems. For instance, we needed to know whether you can find out if a database already has any indexes defined. The manual offered no help, and we concluded that, unless you keep

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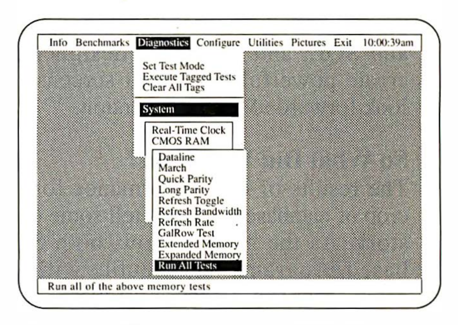
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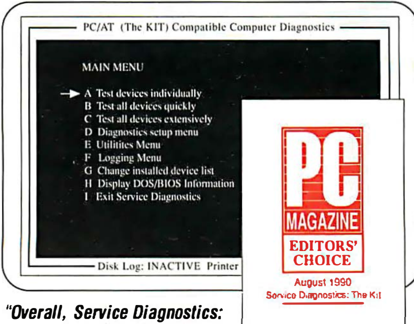
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good notes on your databases, the only way to find out what indexes you have defined is to create an index. If you don't get an error message, you haven't defined any indexes. Can you change a column's data type? Again, no clue... you have to try it. Apparently, you can change its name, but to change its type you have to delete the column and re-create it (which involves an additional update step to put back the data that the delete will destroy) or dip into SQL and issue an `ALTER COLUMN` command.

WindowBase obviously is still rough around the edges and needs a serious performance tune-up. But the package has promising features. It supports DDE and SQL, and the forms designer can create powerful data input screens. We look forward to the next version.

So What Did We Think?

The results of our performance for this crop of database packages tell some of the story. As the graphs show, both SQL-based programs had trouble with our batch-order test. Because we were simply unable to modify our SQL version of the batch-order test to run under WindowBase SQL, no results are posted for that program. Informix could run the test since it permits a `SELECT` subquery within the `SET` clause of an `UPDATE` statement.

FoxPro was the overall performance leader with Clipper and Paradox close behind. Except for the SQL packages, all the products scored very well. In defense of Informix's poor showing, a batch-order processing test doesn't give SQL much of an opportunity to show off its strong points. Those products that could handle items one record at a time naturally fared better.

Our favorite Windows database package was Superbase 4. We were won over partly by its responsiveness, but mainly by its wealth of features. Paradox also is at the top of our list. Its query-by-example format is easily mastered. The documentation is the best you'll find, so you're never far from the solution to any problems that arise with the package. Our only caveat for first-time users is to spend plenty of time toning up their Paradox muscles before tackling PAL.

In the end, though, the laurel wreath went to FoxPro. The interface boasts a convenient mixture of easy-to-use menus and a convenient command window. FoxPro also delivers an outstanding help facility and all the tools for automatic generation of forms, reports, queries, and applications. And its performance is phenomenal. ■

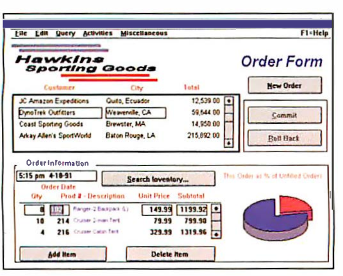
Rick Grehan is technical director and Stanford Diehl is a testing editor/engineer for the BYTE Lab. Rick has a B.S. in physics and applied mathematics and an M.S. in mathematics/computer science. His work with database systems extends back to the late 1970s. Stan wrote the BYTE benchmarks for database applications, notebook computers, monitors, and PCL printers. While in the Air Force, he maintained secure communications equipment for command-and-control operations. In industry, Stan worked at Raytheon as an engineer. Additionally, he developed a database inventory control system for the United Arab Emirates. You can reach Rick and Stan on BIX as "rick_g" and "sdiehl," respectively.

WindowBase

The Windows Database

WindowBase is Easy to Use

Point and click Windows tools assist in defining database tables, in designing forms and reports, and in building simple or complex queries to make retrieving data a snap.



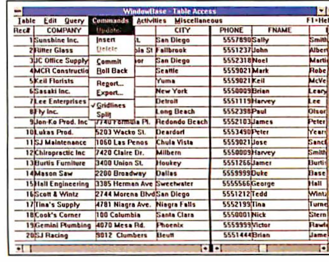
WindowBase is Windows Integration

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HARDWARE

Tweaking Windows:
New Adapters Boost Speed and Clarity

ALAN JOCH

Now that the dust over Windows 3.0 has settled, many businesspeople are finding that this GUI is not without its problems. The performance overhead it levies on standard systems, such as 386s and 386SXs, slows many applications to less than blinding speeds. Consequently, screen redraws, menu displays, text scrolls, and other essential Windows operations can be too slow for some people to work comfortably. For others, these delays are reason enough to avoid Windows.

But in problems lie potential opportunities, and several hardware vendors have recently introduced graphics boards designed specifically to accelerate common Windows functions. I looked at six of these new accelerators: ATI Technologies' Graphics Ultra, Actix Systems' Quantum, STB Systems' Wind/X, Orchid Technology's Fahrenheit 1280, BCC's TIGA-10, and Artist Graphics' WinSpeed 100.

In addition to speeding Windows performance, these boards provide a bridge to another developing trend—the higher-than-standard-VGA resolutions that provide sharper icon and text displays. When teamed with new 15- to 18-inch monitors, which are priced at points that used to define the 14-inch market, the accelerators give businesspeople large, clear, and flicker-free video desktops for the lowest prices ever.

The Playing Field

For this review, I chose boards from vendors that were shipping commercial versions of hardware and drivers in time for testing (more boards will have been introduced by the time you read this). Each adapter includes on-board processors and software drivers optimized to accelerate window scrolls, cursor movement, redraws, and other tasks. All the boards cost less than $900, and some sell for less than $500. All come with 1 MB of video RAM (VRAM).

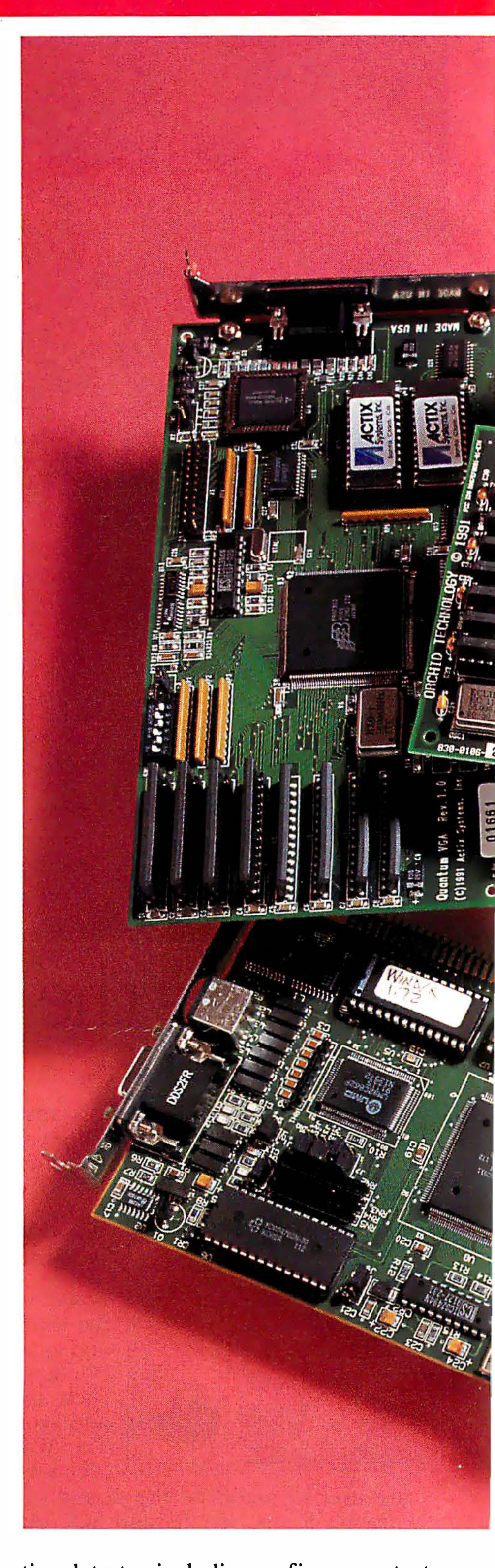
Similarities aside, this group of six show some fundamental differences in approach to the Windows acceleration problem. The most obvious difference is in coprocessors. For example, the boards from Actix, Orchid, and STB rely on the new 86C911 chip from S3, Inc. This VGA-compatible processor boosts Windows performance by off-loading from the CPU such functions as cursor movement, line drawing, and rectangle fills. The other three boards variously use a proprietary processor or competing products from Chips & Technologies and Texas Instruments.

Conceding the tough competition in this market, some of the board vendors don't stop at speeding up Windows: All promised or were shipping drivers for AutoCAD, Lotus 1-2-3, GEM Desktop, Ventura Publisher, and other applications. A couple of vendors sell accelerators that come with a built-in mouse port and mouse. One even includes its own version of scalable screen fonts.

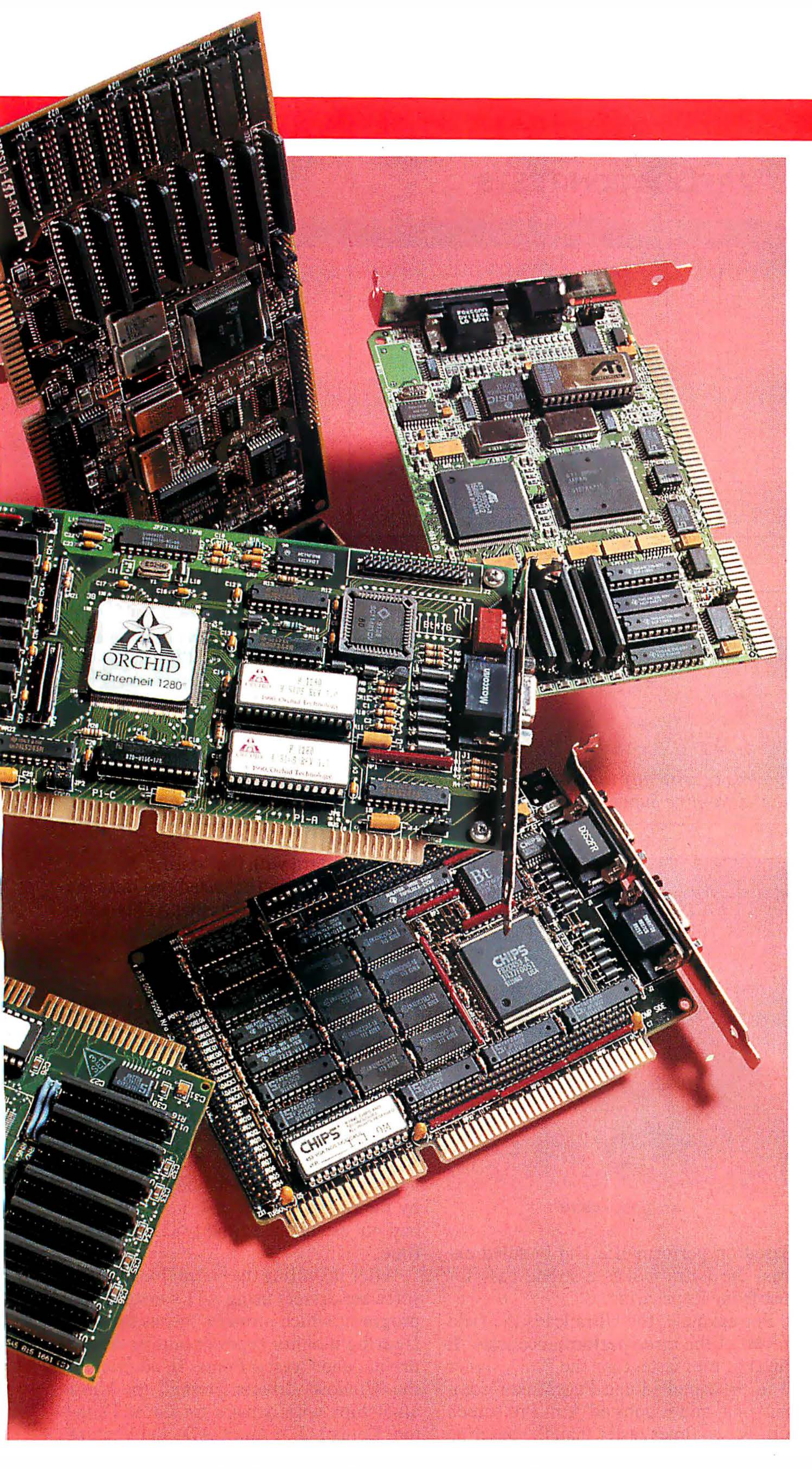
Speed Tests

I tested the boards under Windows 3.0 using NotePad and Windows applications to re-create real-world experiences as much as possible. My test system was a Compaq 386/20 running Compaq DOS 4.01. My monitor was Nanao's FlexScan 9080i, a 16-inch multifrequency display. I tested each board at 1024 by 768 pixels by 256 colors at the highest vertical refresh rate, which for this group of boards was either 70 or 72 Hz.

My objective evaluations consisted of timed tests, including a five-page text scroll within NotePad. I recorded the times of multiple trials scrolling text both forward and backward. Next, I created an Aldus PageMaker file made up of three filled geometric shapes, and I timed horizontal screen scrolls forward



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BYTE ACTION SUMMARY

- **WHAT WINDOWS ACCELERATORS DO**
These graphics adapters provide at least 1024- by 768-pixel resolution and coprocessors that speed standard Windows operations such as screen redraws, text scrolls, and menu displays.

- **LIKES**
Menu selections unfold instantaneously, repositioned windows redraw with a mouse-click, and you can scroll through pages of text two to four times faster than with Super VGA boards.

- **DISLIKES**
The lack of clarity in some displays and only incremental performance increases in others.

- **RECOMMENDATIONS**
The S3-based boards offer the best values in price and performance, and, of these, STB's Wind/X provides the added advantage of a mouse port that can free up an expansion slot.

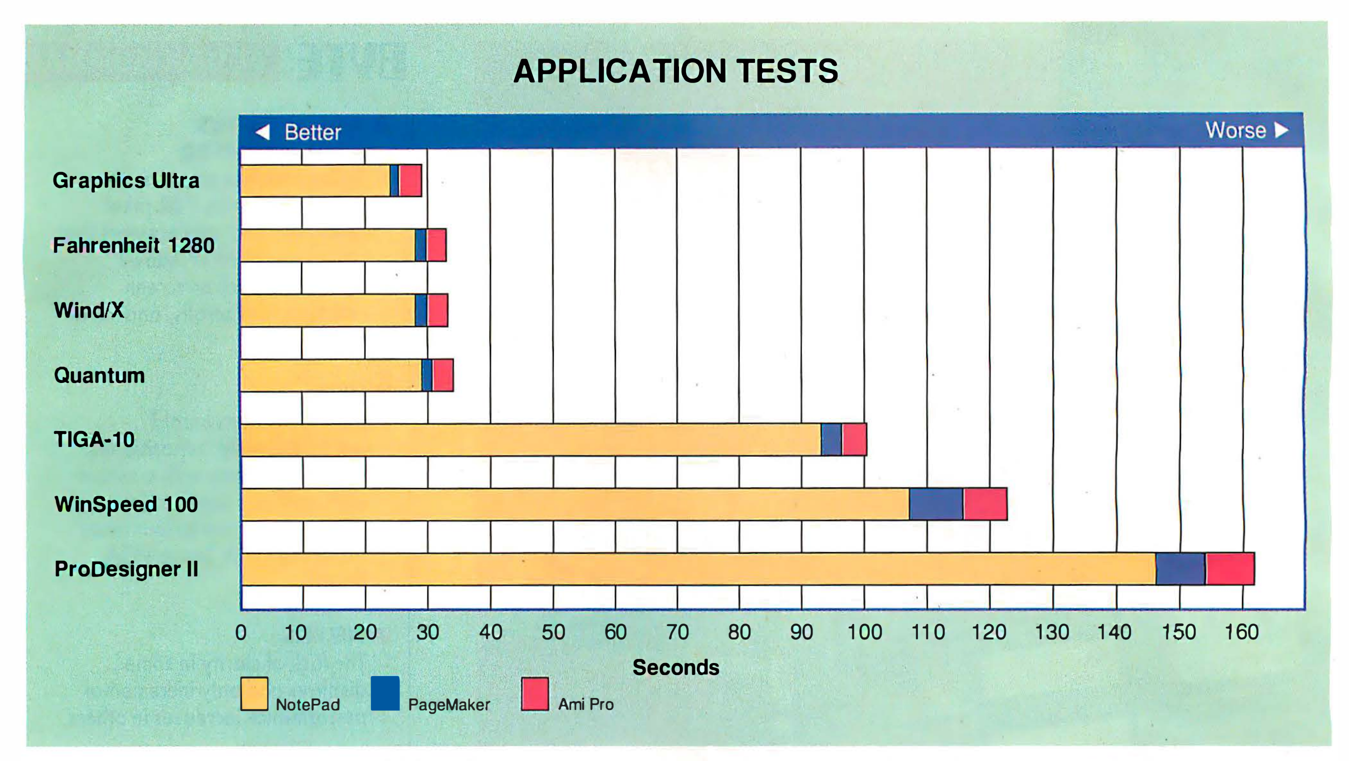
- **PRICES**
Fahrenheit 1280, $499
Graphics Ultra, $899
Quantum, $499
TIGA-10, $495 ($100 for optional VGA daughtercard)
WinSpeed 100, $395
Wind/X, $499

and backward. Finally, I scrolled an Ami Pro text file in 12-point Times Roman in a similar manner. In practice, these tasks can mean the difference between getting your work done efficiently or having enough idle time to ask yourself whether or not the Windows interface is really worth its pokiness.

My baseline comparison was Orchid's ProDesigner II, a 1-MB Super VGA card built around the Tseng Labs ET4000 chip. Although relatively fast, the ProDesigner II isn't optimized for Windows. As the results in the figure show, a natural break appears in the performance rankings. The Graphics Ultra and the S3 contestants were invariably the fastest boards. The 34010-based TIGA-10 and the WinSpeed 100 fell between the leading accelerators and the ProDesigner II. One exception to this came in my PageMaker tests: The WinSpeed 100 actually lagged behind all entrants, including the ProDesigner II.

In the Beholder's Eye

Similarly, I conducted a series of subjective tests to gauge how comfortably I could work in the Windows environment. Because winding through menu trees can be tediously slow on some systems, I



ATI's Graphics Ultra and the three S3-based boards consistently ranked at the top of the performance tests. In most cases, the leading boards ran four to six times faster than the baseline Super VGA adapter, Orchid Technology's ProDesigner II.

judged the speed with which each board displayed pull-down selections and submenus. Timings were impossible because most of the boards sped up response times to a flash.

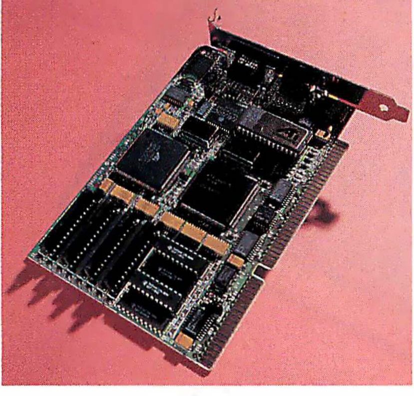
Again my basis for comparison was the ProDesigner II: When I clicked on a main menu selection while running that board, I noted a slight but annoying hitch as I waited for the menu to unfold. Similarly, when I moved open windows around the screen, the redraws were not instantaneous. Only the WinSpeed was unable to eliminate these hitches; the remaining boards boosted redraws enough to achieve an almost immediate response time.

Display quality is also subjective, but I found generally good news in this area. All the boards produced clear displays. Some of them, including the plodding WinSpeed, excelled with crisp icons and text that remained readable even at small sizes.

Overall, each board achieved its stated goal of improving the Windows experience, although differences in effectiveness, degree of acceleration, installation, and price were obvious.

Performance Leader

At $899 for the 1-MB VRAM version, ATI's Graphics Ultra commands the highest price of the tested accelerators.



Graphics Ultra

Based on performance and bundled extras, the Ultra makes a strong case for justifying its price tag.

For example, the Ultra leads the field in two of the three performance tests. It ran six times faster than the ProDesigner II in the NotePad and PageMaker comparisons, and it boosted Ami Pro screen scrolls two times faster than the baseline board.

The Ultra teams a proprietary Mach 8 coprocessor, an 8514/A clone, with an on-board VGA controller for compatibility across the range of low and high resolutions up to 1024 by 768 pixels by 256 colors noninterlaced at 72 Hz. A mouse port and Microsoft-compatible mouse come standard with the board.

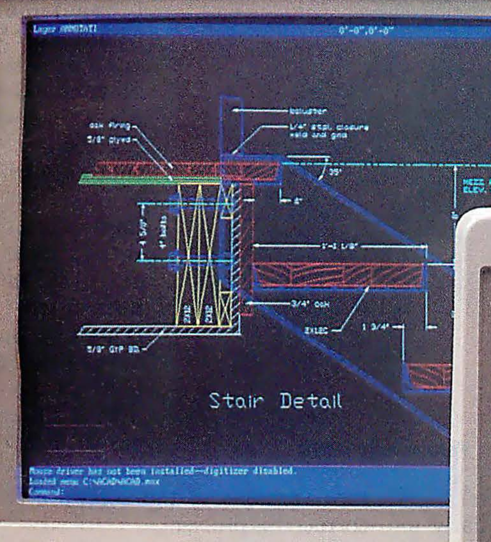
Unique among the tested products are the scalable screen fonts that ATI bundles with the accelerator. Like Adobe Type Manager and similar products, these fonts, called Crystal Fonts, produce high-resolution letters to make proofing and reading of small text easier. Apparent resolution increases, thanks to the antialiasing algorithm that adds shades of gray to smooth jagged edges of letters. ATI plans to offer a package of 35 additional Crystal Fonts and support for True Type and Bitstream and Adobe font converters. The package should be available by the time you read this; however, ATI had not established final pricing at press time.

After installing the board, I loaded the software drivers using ATI's installation program, which provides menus for configuring monitor types or adding device drivers and Crystal Fonts. In addition to the Windows drivers I tested, the Ultra also ships with drivers for GEM Desktop, Lotus 1-2-3, AutoCAD, and Ventura Publisher.

As I've already mentioned, the Ultra placed at or near the top in each of the performance tests. In addition, selected menus and repositioned windows appeared instantaneously after my mouse-clicks.

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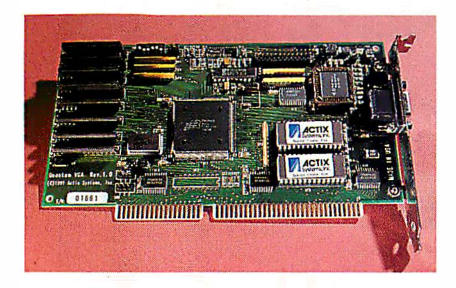
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screen display. The board provided noticeable improvement in display quality over the ProDesigner II, but compared to other contenders in this review, the Ultra's display was lacking. Icons in Ami Pro were recognizable, but the scissors and other toolbox items looked blurry. Also, the boldfaced main menu text looked muddy, while the Roman fonts identifying applications in the Windows Program Manager were fuzzy.

Gang of Three

The S3-based products—the Quantum, the Wind/X, and the Fahrenheit 1280—jockeyed for position at the top of the performance tests. Although the Ultra often prevailed, the lower-priced S3 pack was never far behind. In the three speed tests,



Quantum

the S3-based boards accelerated performance from 2½ to 5 times faster than the ProDesigner II. The base price of each board was $499.

They each offer Windows resolutions of up to 1280 by 960 pixels with 16 colors interlaced at 43 Hz, or 1024 by 768 pixels with 256 colors noninterlaced at 70 or 72 Hz. Upon availability, each vendor planned to offer the Sierra "high-color" RAMDAC and driver for display of 32,768 colors in the 800- by 600-pixel modes. In addition to the Windows 3.0 drivers that I tested, the board vendors also planned to have available by the beginning of the year applications drivers for AutoCAD, Generic CADD, Ventura Publisher, Lotus 1-2-3, GEM Desktop, and other packages.

The Quantum from Actix Systems was easy to install. I needed only to set some DIP switches to configure it for 1024- by 768-pixel operation at 72 Hz. I installed the board's Windows drivers through the standard Windows-installation routine.

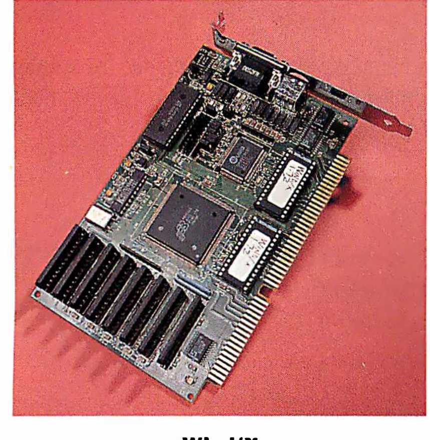
Documentation was sparse, but it did not leave me with any unanswered questions. Once installed, the board provided a crisp display. It never led in any of my speed tests, but it ranged in the upper tier. Actix plans to include the Sierra RAMDAC as part of the board's price (the test board had neither the RAMDAC nor the drivers).

Fahrenheit 1280

The Wind/X performed similarly to the Quantum and differentiated itself with some extras. The board includes a mouse port and Logitech MouseMan. If you already have a mouse installed, you can set a jumper to disable the accelerator-based pointer.

Like other graphics adapters from STB Systems, the Wind/X comes with a D/A converter that accepts the Sierra chip. Pending availability, STB will offer the RAMDAC as a $60 option over the board's base price.

Various jumpers allow you to select 8- or 16-bit BIOS interfaces, depending on whether you'll be running in protected-mode environments. Also, jumpers let you configure system clock speeds for monitor resolutions. I left the default settings in place—except for setting jumpers for 1024 by 768 pixels at 70 Hz, noninterlaced—and plugged in the board. I loaded the drivers from the Windows Setup and quickly had the accelerator up and running.

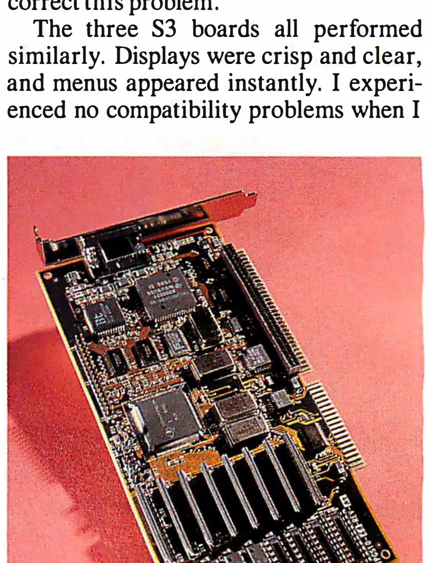


Wind/X

Installing Orchid's Fahrenheit 1280 requires you to check and perhaps reset various DIP switches for monitor resolutions and refresh rates. Software drivers load using the standard Windows Setup.

Overall, the Fahrenheit 1280 performed as I expected based on the results of the other S3-based boards, except that the driver showed a slight bug when I experimented within PageMaker. I drew some squares and rectangles, and when I selected one of the shapes with the Marquee tool and then deleted the shape, unwanted castoffs in the form of stray lines remained on the screen. These lines disappeared with a screen repaint. The company says that future versions of the software should correct this problem.

The three S3 boards all performed similarly. Displays were crisp and clear, and menus appeared instantly. I experienced no compatibility problems when I had Windows set up in standard VGA mode.



TIGA-10

Inexpensive 34010

BCC's TIGA-10 accelerator illustrates how far prices for the TMS34010 coprocessor have fallen recently. Once the domain of higher-end CAD applications, Texas Instruments' 34010 chip is now economical enough to compete in the general business market.

However, taken in this context, the TIGA-10 looks somewhat idiosyncratic compared to its challengers. Lacking

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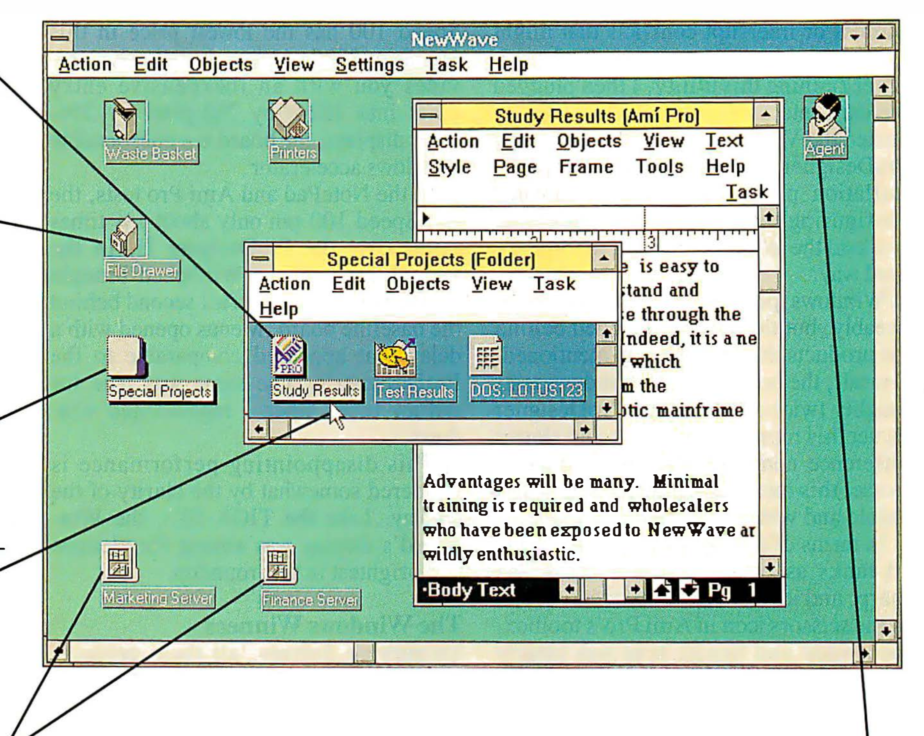
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VGA compatibility, the TIGA-10 must connect to a separate compliant graphics adapter for when you're running DOS or applications without TIGA drivers. As an alternative to this two-slot solution, BCC sells a VGA daughtercard for $100.

As part of the standard package, BCC includes drivers for Windows, AutoCAD, AutoShade, 3D Studio, and WordPerfect with the TIGA-10.

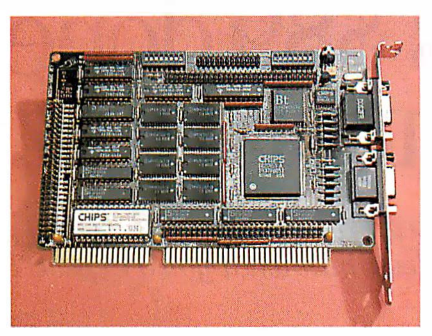
The 60-MHz TIGA-10 displayed a maximum of 1024 by 768 pixels by 256 colors noninterlaced. BCC provides a utility to check for any potential I/O-address or interrupt conflicts that might exist before you install the TIGA-10. After running this utility, I then plugged the card into an expansion slot and connected the VGA pass-through cable to the ProDesigner II in an adjacent slot. An installation program steps you through configuring the board. After rebooting, you load the Windows drivers in the standard way.

Windows performance improved noticeably, but the TIGA-10 lagged behind the products that I've already mentioned. Overall, the board ran the Windows tests roughly twice as fast as the ProDesigner II, yet this represented a clear and slower difference compared to other products. In use, this meant delays in seeing menus unfold and windows redrawn.

In terms of display quality, the TIGA-10 ranks as one of the best. Text was sharp, and icons were easily identifiable. In the scissors icon in Ami Pro's toolbox, each blade and handle hole was clearly defined.

Clear But Slow

Built around the Chips & Technologies 453 processor, Artist Graphics' WinSpeed 100 has the lowest price in this roundup: $395. Although that price provides you with an inexpensive entry point into 1024- by 768-pixel by 256-color displays, the board is a questionable Windows accelerator.



WinSpeed 100

In the NotePad and Ami Pro tests, the WinSpeed 100 ran only about 1 ¼ times faster than the ProDesigner II. In the PageMaker test, the WinSpeed brought up the rear—almost a full second behind the baseline board. Menus opened with a delay that appeared comparable to the ProDesigner's. The same was true for redraw times when I repositioned windows.

This disappointing performance is tempered somewhat by the clarity of the display. Like the TIGA-10's, the WinSpeed's display was among the clearest and brightest in this roundup.

The Windows Winners

To varying degrees, all these products deliver on the promise of faster, high-resolution Windows applications. And as new and more expansive versions of Windows and OS/2 appear in the coming months, hardware-based acceleration may become even more important. The growth of high-resolution, large-screen monitors could also give impetus to the popularity of these boards, as competition forces their prices down to commodity levels.

Then, as now, the accelerators provide a needed boost for those who have committed their workdays to Windows. Although quite economical, the WinSpeed 100 didn't offer enough of a performance advantage to compete effectively in this category.

The TIGA-10, with its proven 34010 coprocessor, is a solid product, but within the narrow context of Windows accelerators, I found other coprocessors to be more efficient. Likewise, I liked the Graphics Ultra's overall performance and appreciated ATI's attempts at value-added extras. However, the Ultra's list price of $899 is more than I'd be prepared to pay if my primary goal was accelerating Windows. For those who also need to combine a powerful processor with AutoCAD display list drivers for faster redraws, pans, and zooms, the capabilities of the Ultra and the TIGA-10 become more valuable.

In the end, I found the prices, speed, and clarity of the S3-based boards impossible to pass up for Windows work. Within this group, price and performance are equal. So, ultimately, I give the nod to STB Systems' Wind/X. I don't need a mouse, but, like many people, I'd love to free up a slot as I plow through Windows applications with greater speed and clarity. ■

Alan Joch is a technical editor for the BYTE Lab. You can reach him on BIX as "ajoch."

COMPANY INFORMATION

Actix Systems, Inc.
(Quantum)
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Santa Clara, CA 95054
(800) 927-5557
(408) 986-1625
fax: (408) 986-1646
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Artist Graphics
(WinSpeed 100)
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ATI Technologies, Inc.
(Graphics Ultra)
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Scarborough, Ontario,
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fax: (416) 756-0720
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BCC
(TIGA-10)
174 Component Dr.
San Jose, CA 95131
(408) 944-9000
fax: (408) 944-9001
Circle 1236 on Inquiry Card.

Orchid Technology
(Fahrenheit 1280, ProDesigner II)
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Fremont, CA 94538
(415) 683-0300
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STB Systems, Inc.
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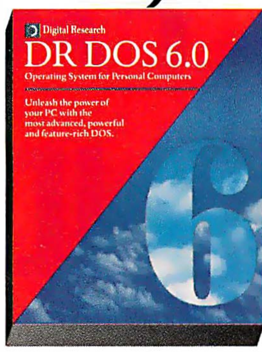
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MAXIMUM MEMORY ON i386 & i486 PCs	575k	621k	627k
MAXIMUM MEMORY ON 80286 PCs	575k	621k	628k
MAXIMUM MEMORY ON 8086/88 PCs	588k	578k	612k
DOUBLE THE STORAGE CAPACITY OF TYPICAL HARD DISK			■
READ & WRITE HIGH-PERFORMANCE DISK CACHE			■
DISK DEFRAGMENTATION			■
COMPREHENSIVE PASSWORD SECURITY SYSTEM			■
UNDELETE		■	■*
TASK SWITCHING (NO. OF TASKS)		14	20
FAST TASK SWITCHING VIA COMMAND LINE OR GRAPHICAL SHELL USING EXPANDED/EXTENDED MEMORY			■
CUT & PASTE BETWEEN TASKS			■
ON-LINE DOCUMENTATION & HELP			■
PC-TO-PC FILE TRANSFER			■
FREE PRODUCT LIFETIME SUPPORT			■
FULLY BOOTABLE	■		■

* EVEN AFTER INTENSIVE DISK USE



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APPLICATION

Ample Waves of Data: Five Tools to Help You Stay Afloat

PETER WAYNER

One of the curses of the computer age is the tidal wave of data that can wash over us each day. For example, my local supermarket now offers coupon discounts to shoppers who provide their names along with cash-register receipts. Although this ruse raises concerns about privacy, I worry more for the poor clerk who must plow through the terabytes of resulting data to discover possible correlations between ZIP codes and mozzarella sales.

Computers helped cause the problem of data overload, and fortunately they can also help solve it. In this roundup, I review five PC and Macintosh software programs designed to help business people, scientists, and engineers analyze endless streams of quantities, ratios, values, and quotients. For PCs, I evaluated Computing Resource Center's Stata, SAS Institute's SAS PC, and SPSS's SPSS/PC+ 4.0. For Macs, I tested Minitab's Minitab 8.0 and Systat's Systat 5.1. (SPSS also sells a Mac version, while Minitab and Systat also sell PC versions of their products.)

The programs are designed for people who must analyze vast quantities of data and make decisions based on the results. For example, marketing directors might use data-analysis software to track demand for their products and determine sales trends based on geography, seasons, or income groups. As these packages look for patterns, they can also plot the sales data in several different formats to make the results accessible to everyone in the company.

A Range of Capabilities

Each program helps you cope with onslaughts of data, but this class of software doesn't collect information and shouldn't be confused with data acquisition programs. Also, this genre doesn't include related programs such as mathematics software (e.g., Mathematica) or scientific visualization packages (e.g., Spyglass).

All the packages I looked at provide simple ways to read the data into the program, perform calculations, and then display the results graphically or numerically. However, there are many differences among the programs. Some, like SAS PC or SPSS/PC+, come with optional modules that provide an extensive range of analyses and graph formats. Others, like Stata, are simpler and not as loaded with features.

Some of the PC packages, including SAS PC, trace their lineage to old mainframe-based statistical software and have user interfaces that seem arcane on microcomputers. Other packages, such as Systat, were written especially for microcomputers and provide a strong interface that would clog the I/O channels of the old mainframes.

I tested the PC programs with a 486-based system running DOS 4.1 with 4 MB of memory and a 105-MB hard drive. My Mac was a IIci running System 7.0 with 5 MB of memory and a 105-MB hard drive.

I evaluated the packages according to four main criteria: range of data-analysis features, numerical stability, presentation tools, and user interface. I analyzed a set of data I had gathered for one of my research projects. The research involved using computers to match artists and their work. Specifically, the data represented the distribution of pen-stroke lengths across a variety of illustrations.

I also ran a sample set of data through the programs to check for numerical stability; this determined how accurately the packages calculated very small and very large numbers. Finally, I evaluated the user interfaces. Naturally, this is subjective, and users of the original mainframe packages may not care a whit about what they can do with the mouse.

Statistical Options

A range and depth of statistical operations is important if your work involves complicated and rigorous statistical analyses. Because of space constraints, I can't list all the analyses possible for each package, but I will summarize each product's range of capabilities.

Each package handles the basic statistics jobs, such as computing medians, averages, standard deviations, and correlations between different parts of the data set. If you construct an equation that models the data, all five packages will do straightforward regression to determine how closely the model actually fits the data. You can do the regression in one swoop, or you can let the computer do it a step at a time and add more and more variables until the model and data match well. All five packages will also analyze the variation (called ANOVA) and determine how well the model predicts the data.

If you want to check your data for

BYTE ACTION SUMMARY

- **WHAT DATA-ANALYSIS PROGRAMS DO**
  They compute various statistical quantities that let you look for trends and patterns in data.
- **LIKES**
  They provide mathematically sophisticated tests for finding patterns and determining whether the patterns could have been caused by random chance.
- **DISLIKES**
  Many of the user interfaces were rudimentary and not well designed.

RECOMMENDATIONS
For Mac-based statistical analyses and presentations, choose Systat. Although rigorous in its complexity, SAS PC reigned as the most complete package for PCs.

- **PRICE**
  Minitab 8.0 for the Mac, $695 (single-copy price)
  SAS PC 6.04, $595 (one workstation, first-time license, must be renewed annually for $275)
  SPSS/PC+ 4.0, $195
  Stata 2.1, $590
  Systat 5.1 for the Mac, $795 (Mesosaur time-series statistics module, $395)

consistency, all five programs will compute the basic set of statistics, including the t-test, the Kolmogorov-Smirnov test, and many other nonparametric tests. These tests let you determine whether the data is likely to be from a predictable source. The Kolmogorov-Smirnov test, for instance, is useful for checking whether the variable was produced by a perfectly random source. The t-test is useful for determining whether the difference between the means of two samples could have occurred by chance.

Stata, Systat, SPSS/PC+, and SAS PC also perform cluster analysis for segmenting several sets of data into subsets with similar characteristics. These four can also do factor analysis. The latter is a more complicated version of regression in which different variables are grouped into meta-variables called factors; the influence of these factors is then computed.

SPSS's optional Advanced Statistics package provides sophisticated versions of nonlinear-regression and multivariate-regression variance analysis. Multivariate regression addresses numerous variables that might be related to the data. Both regression analyses are also available in SAS PC's main statistics package and in Systat and Minitab.

Systat, Minitab, SAS PC, and SPSS/PC+ offer packages for analyzing functions that vary with time. The basic purpose of time-series analysis is to look for trends and counteract seasonal variations. Minitab builds these functions into the main module; the other three programs offer theirs as options. Stata provides some of these functions, but not enough for me to consider it a contender in this area.

With the Systat and Minitab versions of time-series analysis, you calculate a Box-Jenkins ARIMA model of the data. This model is helpful for looking for seasonal or periodic variations in a time-dependent variable. Both packages make it easy for you to analyze graphically the auto-correlations between different times and discover any periodic differences. Systat provides many built-in functions for smoothing data.

SPSS and SAS offer more sophisticated time-series systems than either Systat or Minitab. SPSS/PC+ and SAS PC will estimate the various frequencies of seasonal variation with Fourier analysis. This lets you determine whether there may be more than one pattern at work (e.g., vacation passenger loads on airliners are higher on Fridays and in the summer). Both programs also offer the X11 ARIMA package, which was developed by government agencies to do seasonal adjustments of monthly data. SPSS's version comes from Statistics Canada; SAS's version comes from the U.S. Census Bureau.

One important element in handling seasonal data is dates. Although time may be a continuum, the way we represent it is more complex. Systat, SPSS/PC+, and SAS PC offer ways to handle the standard day, month, and year format. SAS, for instance, converts a date into the number of days between it and January 1, 1960. Thus, July 4th, 1776, becomes −67019. If you are using the time of day as well, SAS stores this as the number of seconds from midnight, January 1, 1960. Minitab sees time-series data as simple sequences with data numbered case 1, case 2, and so on. These data-handling features make Systat, SAS, and SPSS much easier to use for large projects than programs that don't address the calendar format.

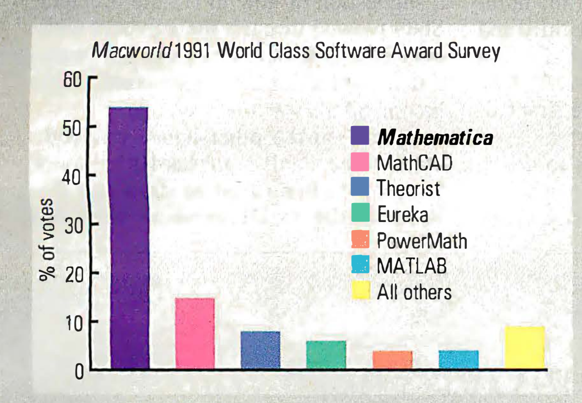
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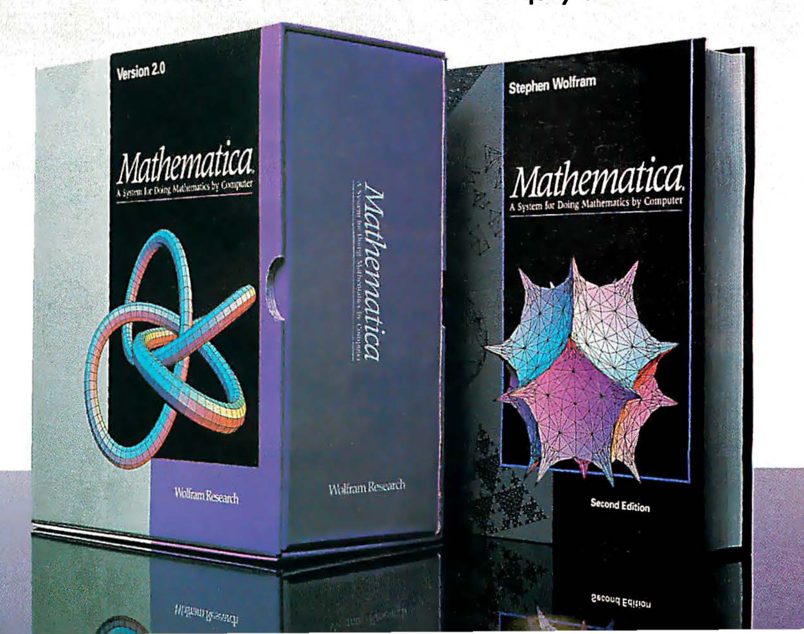
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SAS PC and SPSS/PC+ have many esoteric options too numerous to name here. SPSS/PC+, for instance, offers a separate package called CHAID, which performs sophisticated cluster analysis based on the chi-squared test and tree analysis. SAS offers a separate package devoted to manufacturers who do quality-control analysis. (At press time, Minitab introduced a similar package.) SAS also sells a package for managing operations such as network flow calculations or linear programming.

It is impossible to say which package is the most sophisticated for data analysis. They all handle the core group of features successfully. For Mac-based analyses, both Minitab and Systat provide an equally solid core of the standard statistical methods. For PCs, SAS PC has the widest range of add-on features, so if you need very complicated procedures, SAS PC is the standout program.

Numerical Stability

One of the most important features of a statistical package is numerical stability. Some software is written by people who are careful to ensure that the mathematical operations are done with high precision. Other programs are looser and sloppier when handling small and large numbers.

The range of acceptable numbers can cause problems. Minitab can only handle numbers between 10^{-13} and 10^{13}. The manual suggests that you can rescale that particular set of data when you get near the boundaries of accuracy. This fix, though, is cumbersome and potentially confusing if you are not expecting it. Every package has some limitation, but most are much better than this. Stata, for instance, can handle numbers between 10^{-99} and 10^{99}.

To test the number-crunching abilities of each program, I created a simple file with five variables and nine cases. In the first variable, I placed the numbers 1 through 9. In the second, I put the numbers 10001 through 10009. The third and fourth columns were filled with the first and second columns divided by 10^8. The fifth column was filled with the first column divided by 1000.

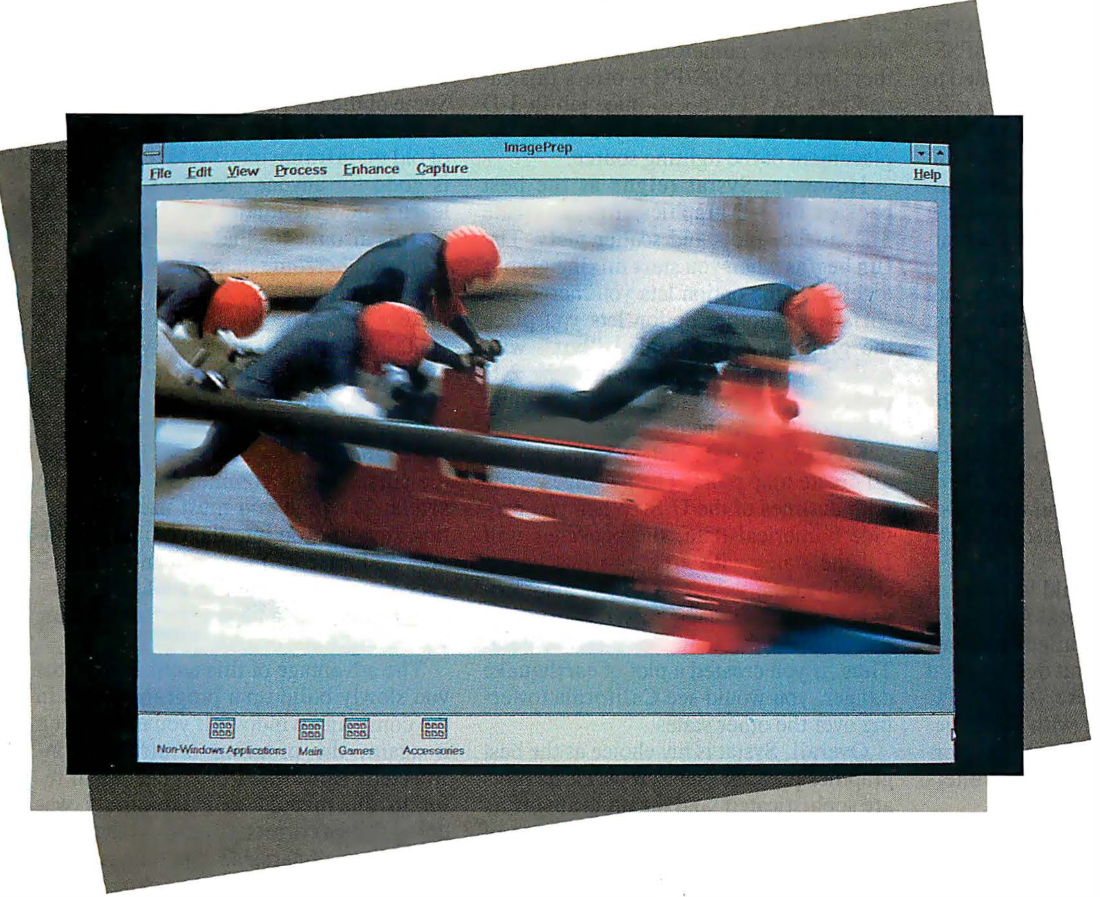
The purpose of the test was to determine how well the programs responded to numbers in a wide range of sizes. The numbers between 10001 and 10009 tested the programs' ability to recognize small variations in size. These numbers were within the range of acceptable values for all five programs.

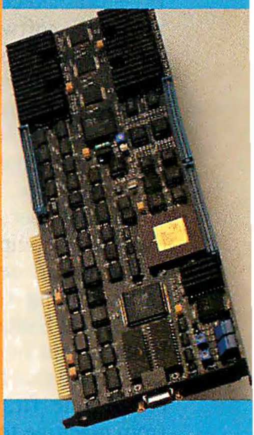
My test demanded that the programs fit a line to all possible pairs of variables. The numbers should generate perfect lines, but the sizes throw the packages a bit of a curve. The results were quite varied.

Only Stata and SAS PC handled all 10 cases without trouble. Both SPSS/PC+ and Minitab refused to handle the sensitive cases when the numbers 10001 through 10009 were the dependent variables. These packages said that the numbers were too close to a constant. SAS noted this problem, found an answer, and then warned of a potential error with a suggestion of how to fix the problem. Stata plowed through the numbers without a blink and did not warn of any potential instability. I felt more comfortable having SAS's warning message.

Systat, on the other hand, was bothered by the small numbers 10^{-8} through 9×10^{-8}. It refused to draw the line because the small numbers were too

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When I experimented with exceptionally large numbers (e.g., 10^{129}) SPSS/PC+ crashed completely and I needed to restart the software. This could be a rude awakening if you are in the middle of a calculation that goes awry. SAS PC managed to fit a line to numbers with magnitudes such as 10^{100}, but occasionally it got the *y*-intercept wrong. Stata truncated their values.

The data set I used in this case is not especially complex or sophisticated, but it did reveal several important differences among the programs. Minitab, SPSS, and Systat each refused to do the problem and forced me to rescale the results. Note that I did not test the accuracy of the line fit, because this will vary from machine to machine and more specifically from math coprocessor to math coprocessor.

Mac-based analysts should be wary of using either Minitab or Systat with difficult numbers. Minitab failed to draw some of the lines, and Systat decided that many small numbers were 0. The PC users should be happiest with SAS, because it had no problems; Stata's performance, however, made it a viable alternative.

Presentation Power

The graphical presentation of data can be just as important as equation crunching. In many cases, you can spot important correlations when the data is graphed in the correct way.

Each package offers basic graphs, including scatter plots, that let you look at the relationships between two dimensions of data, bar charts, pie charts, and box charts. These graphs are handy ways to visually describe the mean and standard deviation of a set of data. Histograms and line drawings are also all standard with the reviewed packages. Each of the five packages can handle this basic set of graphs.

All the programs also let you combine these graphs in many different ways. You can overlay or juxtapose the basic graph primitives. Stata, SAS PC, and SPSS/PC+ will place a symbol at each point in a scatter plot and let you scale the symbol in relation to data. For example, Systat's graphics package will let you use several different variables to control the shape of the symbol. Thus, a big blob at the twelve o'clock position of the symbol would signify a big value of one variable, and the size of the protrusion at six o'clock might signify another symbol. Systat will also allow weather vanes to signify direction at a certain place.

Also important for data presentation are 3-D graphics, which show relationships among numerous variables. Neither Stata nor SPSS/PC+ offers this capability. SAS PC does a nice job in 3-D graphics, and it even lets you select the placement of the lighting source.

However, Systat reigns as the best package for 3-D graphics. You can create 3-D surface plots and scatter plots. The fun begins when you start mixing graphs together. One option lets you merge two surfaces. Another option lets you place the graph in a three-sided "box" with scale tick marks. Systat can draw 2-D plots on these walls to bundle even more information into the package.

SAS PC, Systat, and SPSS/PC+ can all create map plots. The packages come with outlines of the U.S. When you provide numerical data, the packages will fill the states with a pattern that corresponds to the values. SAS PC also provides a neat 3-D map option that extrudes the shape of the state based on the data. Thus, if you created a plot of earthquake danger, you would see California towering over the other states.

Overall, Systat is my choice as the best graphics package (see screen 1). Its plots are sophisticated, and the program offers many different format choices. Some of the dialog boxes might be a bit clearer, but even so, the boxes are still better than the rest.

For PCs, SAS PC provided the best graphics among the test programs. It even had some sophisticated options that Systat doesn't provide. Stata offers good 2-D graphics. SPSS/PC+ is the worst among the test packages. If you ask for a plot, you will get one generated by the program's old teletype interface. The mapping software is the only integrated graphics format in the program. For other types of graphics, you must use SPSS/PC+ with Harvard Graphics or Graph-in-the-Box.

User Interfaces

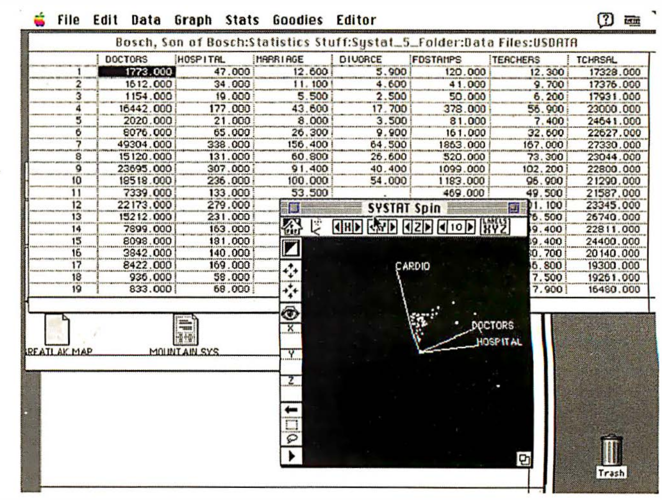
Some of the PC packages were developed before the rise of GUIs, and the remnants of old mainframe interfaces live on. This is good for anyone who doesn't want to learn a new command set. Unfortunately, this also means that some systems are more cumbersome than they need to be.

For example, SPSS/PC+'s GUI is merely OK. The top half of the screen contains a tree-like menu system with every possible command in the SPSS repertoire. At the bottom of the screen is a command window. When you select a command, the program types it for you at the cursor in the command window (see screen 2). Then you must use the function keys to drop into the command window and execute the command. Experienced users will want to avoid the menu system and the added effort of looking for the right command.

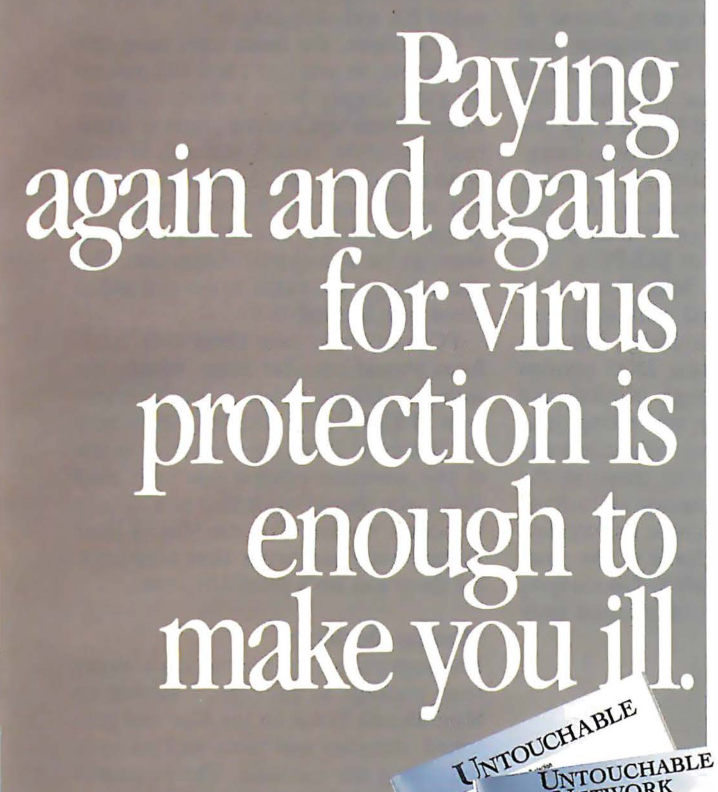
The advantage of this technique is that you slowly build up a program to run in the command window. If you need to run it again, the program is already constructed. However, I often needed to refer to the manual to make sure I was doing things correctly, because the menu will allow unparsable commands to be generated.

The SAS PC environment makes even fewer nods to the invention of the GUI (see screen 3). The interface provides three main windows: one for a program, one for commands that run programs, and the third for the data. However, this interface is not just a leftover from the mainframe days, it's a form of torture.

When I first tried to get the simple introductory example working, I failed repeatedly. If I made one mistake, I would get lost in a maze of errors. To make



Screen 1: *Using data contained in an easily edited spreadsheet format (background), Systat builds three-matrix scatter plots (foreground) and other sophisticated presentation formats.*



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matters worse, SAS PC erased my carefully typed lines, so I would need to retype them to try again. I only discovered that F9 was a magic recovery key after retyping the commands twice. I eventually got the hang of the program, and all these problems were technically my fault, but I think a better-designed interface would fix many of them.

SAS offers two solutions. One is called SAS/AF, which is another programming language that enables you to create menu-driven applications for SAS. It is a product for programmers who need to create easy-to-use interfaces for clerks and data-entry people. A program called SAS/Assist is a menu-driven alternative to running with the standard SAS interface, but it is not as flexible as basic SAS.

The other solution is the new SAS for Windows, which is scheduled to be released by the time you read this. The mathematical core of SAS is very solid, and Windows may provide it with a more competitive user interface.

Using the main Stata program is like using a teletype. This doesn't mean it is complex, however, and I had no problem using it. The command syntax is a bit unusual, but you'll be able to figure it out. For instance, you need to type `exit, clear` to leave the program instead of simply typing `exit`. The program also has a set of menus and dialog boxes that are similar to the Mac interface. You choose a command and fill out some box selections, and the program does everything immediately. There is no interplay between command window, menu, and program. This was an easier interface to use than SPSS/PC+'s or SAS PC's.

On the Mac side, both Systat and Minitab have menu and command windows that work symbiotically, but they differ greatly from their DOS cousins (see screen 4). Although Minitab and Systat are technically converting your mouse-clicks into typing in the command window, you need never move to the command window to execute an instruction. Often, you can ignore the window entirely if you want. Some of the more complex operations, such as file merging in Systat, can be accomplished only through the command window, but I had no problem doing real tasks without it. Many repetitive and complex tasks are better accomplished by creating a command file and executing it.

In addition, the menu trees have only two levels, so you don't feel like you are digging deeply for a particular command. When you select a graph or statistical operation, both Systat and Minitab open up a dialog box that lets you set the rest of the options. Systat's menus are graphically based, and although this may seem to be a cosmetic distinction, this menu design was easier to use and understand than Minitab's.

PC users who care about user interfaces should consider Stata, which, despite its idiosyncrasies, is much cleaner than SPSS/PC+ or SAS PC (see screen 5). However, if the user interface is one of the selection criteria you care most about, you should buy a Mac or wait for a Windows version. For the Mac, I liked Systat's interface better than Minitab's, but there was not a great difference.

Screen 2: *SPSS/PC+ executes analyses from tree-like menu commands, which are displayed at the bottom of the command window as you select them. Ultimately, this interface proved tedious.*

Screen 3: *Although SAS PC was the most sophisticated package overall, its command window will seem antiquated to many PC users.*

Manual Dexterity

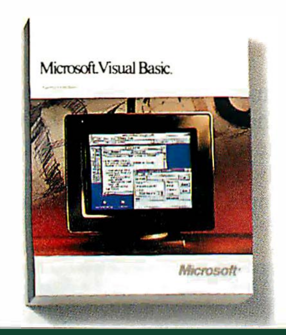
The importance of the manuals varies from package to package. I started up Minitab and Systat on the Mac and generated statistics and plots without even consulting the manuals. The interfaces are good enough to make things easy. Only when I attempted some complicated tasks did I need to turn to the manuals. However, the three PC products are impossible to use for the first time without the manual next to the machine. The companies recognize this, fortunately, and offer nice hand-holding segments, like quick-start guides, at the beginning.

The manuals vary widely in writing style. Parts of the SAS manuals seem aimed at Ph.D.s, while Stata's manual is chatty. Both Systat's and Minitab's are straightforward and simple. SPSS's manuals spell out every detail.

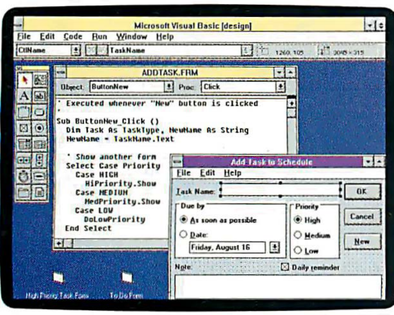
The range of information about statistical analysis also varies among the manuals. Large parts of Minitab's manual cannot be understood by statistics novices. The SPSS and Systat manuals do a better job of providing solid introductions to the subject. SPSS's time-series manual, for instance, offers 13 case studies showing how statistical methods can be applied to analyzing data.

Most of the manuals were good, but I truly enjoyed reading some of SPSS's because of their completeness, including plenty of case histories. So, when using a PC, I would choose SPSS's manuals. For the Mac user, it's a toss-up, but Systat's are generally better than Minitab's.

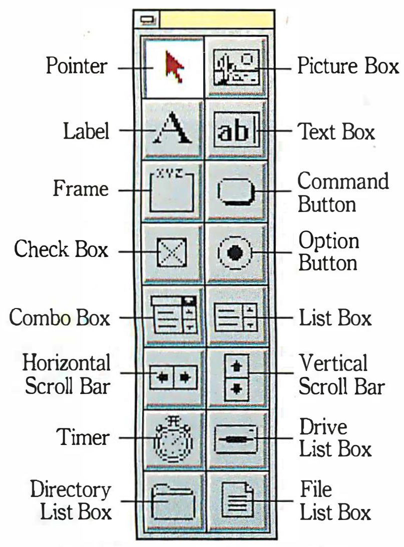
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- Incorporate bitmap graphics, metafiles, and icons.
- Sophisticated debugging tools.



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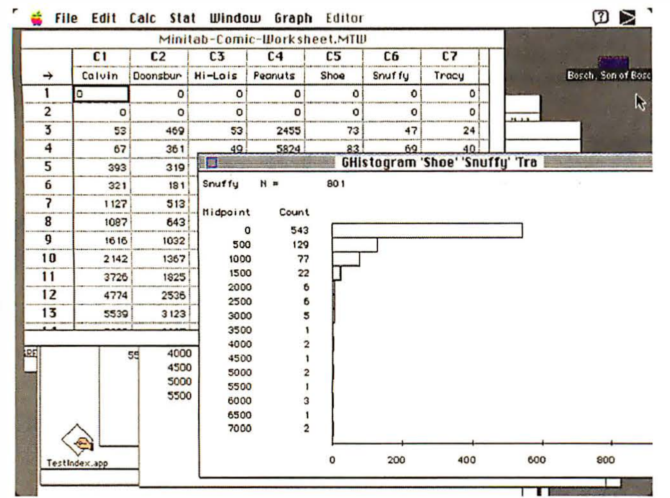
At the 1991 Spring Comdex/Windows World, the editors of BYTE *judged Visual Basic the "Best of Show." In the July 1991 issue of* BYTE, *Editor-in-chief Fred Langa called Visual Basic "a milestone product."*



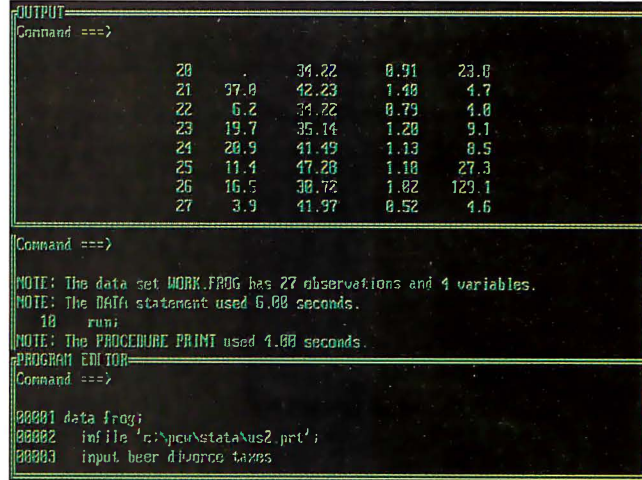
What to Choose

In the end, there are many different reasons for buying data-analysis packages, so any recommendations about which of these five to buy depend on your applications. If you are Mac-based, your work involves moderate-size jobs, and you are mainly concerned with producing graphs and seeing how well a model matches the data, I recommend Systat. The Macintosh version is quite sophisticated and user-friendly. The Minitab software also uses the Macintosh user-interface paradigm well, but the program does not have as large a range of graphics as Systat. Stata is certainly a solid choice: Its user interface is simple, and the statistical core is solid.

continued



Screen 4: *Although Minitab faithfully adheres to the style of the Macintosh environment, the program's graphing abilities fall short of those of other data-analysis packages.*



Screen 5: *To build charts and graphs within Stata, you simply enter commands into input boxes at the bottom of the screen, and then the program does everything immediately.*

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SAS PC and SPSS/PC+ are good choices for people who already know the respective languages or who are considering implementing a large data management system. Both packages offer data-entry front ends that allow statistics novices, such as store clerks, to enter information without regard to what the statistics experts may do with the data later. These packages also offer a wide range of specialized statistics capabilities that you can purchase as options. For its overall sophistication, I give SAS PC the nod for PC-based analyses. ■

Peter Wayner is a consulting editor for BYTE. He is also working toward a Ph.D. in computer science at Cornell University. You can contact him on BIX as "pwayner."

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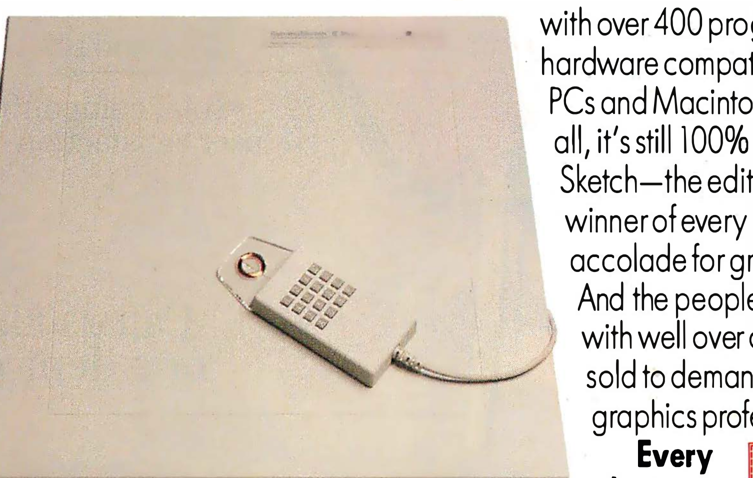
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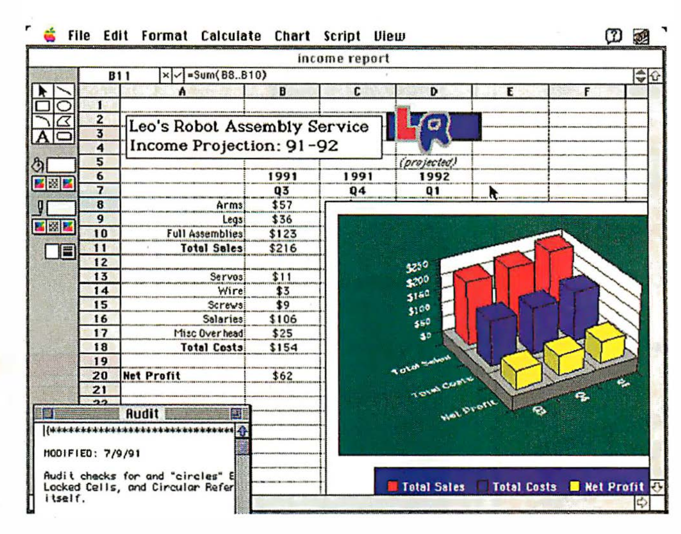
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APPLICATION

Claris Enters the Spreadsheet Wars

CHRISTOPHER R. GIBSON



In Resolve, chart (the 3-D bar graph), text (the title block), and graphics objects (the logo) are independent entities that share the display space with the worksheet grid.

The battle for the hearts and minds of Macintosh business users has heated up again with the release of Resolve 1.0, Claris's System 7.0-savvy spreadsheet. Based on technology from Informix Software (the maker of Wingz), Resolve boasts the same impressive performance, graphics, and scripting that made Wingz such a big hit.

Claris has sweetened the pot by adding a smooth interface and support for the Interapplication Communication (IAC) functions of Apple's System 7.0. Resolve's array of capabilities aims this $399 spreadsheet squarely at both Microsoft Excel—the primary force in the Macintosh spreadsheet market—and the up-and-coming Lotus 1-2-3 for the Mac.

Friendly Front End

The professional Claris design is evident even before you launch Resolve for the first time. The reference materials are thorough and well designed. They include a user's guide, a functions and scripts reference, and a getting-started guide with clear installation instructions and an effective half-hour tutorial.

Installation is made quick and easy by the familiar Installer, the same utility that comes with Apple's system software. Resolve is not small—the application alone weighs in at almost 1 MB, and complete installation requires 5 MB of disk space. Claris has eased the situation by allowing Resolve to share files (e.g., dictionaries) with other Claris products. While Claris claims that only 1 MB of memory is required to run Resolve under System 6.x, plan on 4 MB of RAM to run comfortably under System 7.0.

The distinctive Claris look is obvious with Resolve. Each document window is split into two basic elements: the *palette panel*, which includes drawing-tool palettes similar to Claris's MacDraw II, and the *worksheet grid*, which contains the cells and formula bar common to most spreadsheets. When you're not using Resolve's graphics tools, the palette panel can be hidden with a click of the mouse.

Operating Resolve is intuitive for anyone who is familiar with spreadsheets. In the worksheet grid, you type data and formulas into cells. Virtually everything other than cell data is treated as a resizable, movable "object" that sits over the worksheet grid (see the photo). Objects include graphics figures (e.g., circles and polygons), text objects to hold large blocks of text (including scroll bars if required), and buttons that can be linked to scripts. To create a graphic, you just select the tool you wish to use and start drawing right on the worksheet grid.

Resolve's powerful, if somewhat inflexible, charting abilities are also easily accessible: You select the data to graph, and Resolve creates one of 25 charts as an object on the worksheet. As in Wingz, text, graphics, and chart objects exist on a layer above the worksheet cells, leaving the data underneath untouched.

Behind the Interface

The graphics power of Resolve is so impressive that it's easy to overlook the power of the underlying spreadsheet engine. Resolve's manual lists a full suite of 147 business, statistical, mathematical, and text functions. The package even has functions for matrix math (including solving simultaneous equations)

BYTE ACTION SUMMARY

- **WHAT CLARIS RESOLVE 1.0 IS**
  Claris Resolve is a full-featured spreadsheet for the Macintosh.

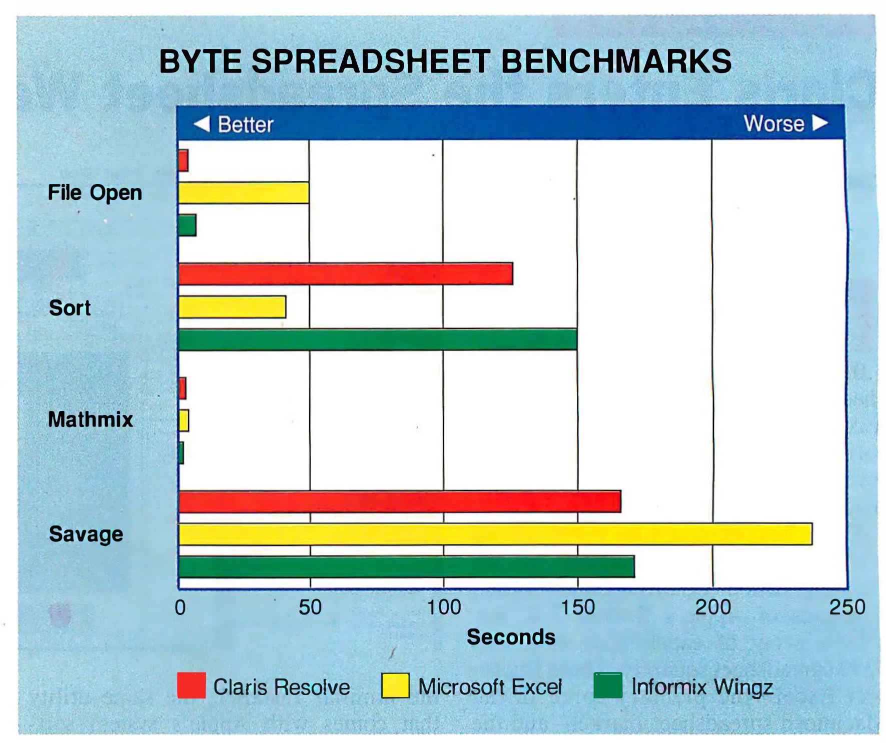
- **LIKES**
  Every major spreadsheet feature—graphics, scripting, and fast calculation—are very well implemented. Resolve makes good use of System 7.0's IAC capability. Finally, Resolve caps these features with a clean, intuitive interface.

- **DISLIKES**
  Some convenience features—most notably split windows and a multiple-line formula bar—are missing from the interface.

- **RECOMMENDATIONS**
  Resolve's solid features and excellent performance make it a good choice for those considering a new Macintosh spreadsheet.

- **PRICE**
  $399

- **FOR MORE INFORMATION**
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Notes: File Open is the time it takes to open a 1.2-MB file. BYTE's Sort benchmark is a timed sort of several thousand records. Mathmix is a test that indicates relative integer performance. The Savage benchmark is a measure of floating-point performance. For a full description of these tests, see "Not Just for Numbers Anymore," February 1990 BYTE.

All benchmarks were run under System 7.0 on a Mac IIsi with no FPU, 5-MB RAM partitions for the application, and the minimum system RAM cache of 16 KB.

and frequency distributions. Resolve also provides database facilities similar to those in Excel, where a portion of the spreadsheet can be defined as a database, and various database functions allow you to search, manipulate, and extract values as you would with any database.

If there's a function you need that Resolve doesn't have, you can roll your own using Resolve's scripting language. But Resolve Script, which resembles HyperCard's HyperTalk, goes far beyond user-defined functions. Resolve Script not only lets you record and store repetitive actions, but it also allows you to manipulate almost every facet of the Resolve interface, including menus and dialog boxes. Scripts can be stored separately, or they can be attached to objects in a worksheet. Scripted event handlers can fire off actions at specific times, such as when a worksheet is opened, closed, or recalculated. With all these features, Resolve Script is powerful and flexible enough to allow you to develop spreadsheet-based applications within Resolve.

The performance of Resolve's spreadsheet engine naturally rivals Wingz's for best in its class. Using the BYTE spreadsheet benchmarks for comparison, Resolve easily bested Excel on most common operations; it showed times similar to those of Wingz (see the figure). Resolve clocked in with recalculations at least 30 percent faster than Excel's on the math-oriented Savage and Mathmix tests, but Resolve's speed isn't limited to number crunching. Opening and saving large spreadsheets in Resolve is refreshingly speedy. Even the largest spreadsheets—which took Excel almost a minute to open—were open and ready to run in less than 5 seconds with Resolve. Unfortunately, Lotus 1-2-3 for the Macintosh wasn't available at this writing, so I was unable to make performance comparisons between Resolve and 1-2-3.

Resolve's one performance weakness is its slow database sorts. On BYTE's Sort benchmark, Excel outdid Resolve by a factor of 3 to 1. Claris says it put most of its effort into optimizing common spreadsheet operations for this first release, and it is working on more performance optimizations for the future.

System 7.0 Savvy

Resolve is fully System 7.0 savvy and makes excellent use of the advanced IAC features available under System 7.0's Edition Manager (commonly known as Publish/Subscribe). The Edition Manager allows a program running under System 7.0 to publish certain areas of a document and then lets other programs subscribe to these published items. This

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is accomplished using *editions*, which are documents stored on disk that contain both shared data and lists of subscribers. Changes made in a published document generate changes in its editions; the Edition Manager updates subscribers using Apple events, the high-level IAC architecture built into System 7.0.

For example, say you need to include in your company's annual report the financial data in a Resolve worksheet. You would select the data to share and choose "Create Publisher" from the Edit menu to create an Edition file on disk. Then you'd switch to your System 7.0–savvy word processor, load the report, choose "Subscribe To," and select the Edition file to complete the link.

From then on, any changes in the Resolve worksheet will be transparently communicated to your word processor so that the annual report will always display current data. Using System 7.0's file sharing, this communication can even take place between different Macs on a network. The Publish/Subscribe mechanism is nearly transparent, and the speed with which changes ripple through to the subscribers is surprising.

A Few Rough Edges

Resolve is a robust program, but a few missing interface elements mar an otherwise excellent package. They range from small things, like the lack of auto-scrolling when moving charts and the lack of a progress indicator for lengthy operations, to more serious deficiencies. The most disappointing of these are a one-line formula bar, which makes building complex formulas difficult, and the inability to split a window into multiple panes, which makes adding formulas to a large worksheet needlessly cumbersome. I'd also like to see an auto-sum feature, similar to Excel's, in a future release.

There's little doubt that Resolve has the right stuff to go head-to-head with Excel in the business market. Its few shortcomings are interface issues that can be easily addressed, and its core spreadsheet and scripting technology will set the standard for some time to come. Perhaps most important, Resolve provides System 7.0's IAC capabilities today and demonstrates how powerful—and simple—these features can be. ■

Christopher R. Gibson is president of Cloud Ten, a Macintosh software development firm in San Luis Obispo, California. Chris is a moderator of the BIX Macintosh exchange. He has also taught spreadsheet classes since 1989. You can contact him on BIX as "chris.gibson."

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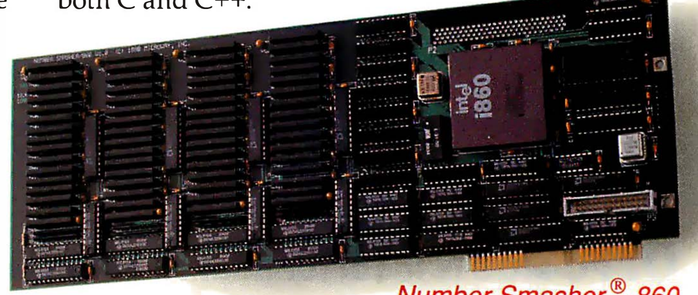
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SOFTWARE

DOS Extenders: Raising the Ceiling

MIKE BLASZCZAK

DOS developers have long struggled with the limitations of the PC environment. Strapped in by the backward compatibility of DOS, developers could only look longingly at the advanced features of the 286, 386, and 486 processors. DOS, running in real mode, demotes all these to the rough equivalent of the 8086. How can you develop memory-intensive programs without sacrificing DOS or relying on workarounds such as overlays?

The solution is DOS extenders. Simply stated, these allow you to create DOS programs that run in the protected mode of Intel's more advanced processors. Many vendors offer DOS-extender packages, which vary in their scope and features. The BYTE Lab staff selected four packages for comparison: Rational's DOS/16M and DOS/4G packages, Intel's 386/486 C Code Builder Kit, Symantec's Zortech C++, and Phar Lap's 286|DOS- and 386|DOS-Extender Software Development Kits (SDKs).

Protected Mode

The 286, 386, and 486 processors all support a protected mode of operation. However, the Intel 286 chips are somewhat limited compared to the 386 and 486 chips. For example, the 286 can access only 16 MB of memory, while the 386 and 486 can virtualize their address space to manage 4 gigabytes of memory.

As a result, extenders for the 286 are significantly different from those for the 386. Some vendors, such as Phar Lap and Rational, offer separate packages for each processor type. And while Symantec's Zortech C++ compiler supports 286 and 386 systems, Intel's C Code Builder Kit generates only DOS-extended 386 and 486 code. While it is possible to run 286 DOS-extended applications on 386 and 486 processors, the converse is not true; the 286 can't support the expanded functionality of its more powerful counterparts.

Compilers and Assemblers

Two of the packages in this group aren't merely DOS extenders but complete development systems, compiler and all. Symantec's Zortech C++ is the most elaborate, since it implements version 2.0 of AT&T's specification for C++. It is capable of generating code that is compatible with Microsoft Windows (without requiring the Windows SDK) as well as with OS/2 and DOS. The Symantec package includes royalty-free 286 and 386 extenders but is also kind enough to support code generation for 286 extenders from Phar Lap and Rational.

Intel's compiler accepts only C, but it is designed to be somewhat compatible with the Microsoft C Compiler. Since many incompatibilities exist between the Intel and Microsoft compilers, the Intel manuals contain sections that explain the differences between the compilers. Most notably, the Intel compiler does not support mixed-language programming keywords.

Unfortunately, the Intel compiler does not support the _asm keyword for in-line assembly language. While some simpler assembly language operations can be emulated by special functions provided in the C Code Builder Kit run-time library, many users of in-line assembly language will have to invest in a compatible assembler. Zortech C++ and the Rational development kit both lack assemblers.

Phar Lap's 286|DOS- and 386|DOS-Extenders include assemblers capable of producing protected-mode code. These packages are roughly compatible with the Microsoft Macro Assembler and should present no problem for programmers with MASM experience.

The 386 extenders from Phar Lap and Rational are compatible only with 32-bit compilers (e.g., those from Watcom and MetaWare). Rational's DOS/16M package is compatible with a broader range of compilers but is very difficult to install. Installation instructions are spread throughout the manual, and you must manually copy the files to the hard drive. Phar Lap's 286|DOS-Extender supports an equally impressive list of compilers and includes an installation program that makes it easier to install.

Virtual Memory Management

Intel's C Code Builder Kit and Rational's DOS/4G package provide virtual memory managers that use disk space to simulate a larger address space than might be physically available. DOS/4G has a stronger VMM that you can configure at run time. Intel's VMM can only be configured at compile time. Neither vendor gives many hints or rules for optimizing the performance of their VMMs.

The Zortech compiler's 386 extender and Phar Lap's 386|DOS-Extender SDK do not support virtual memory. As a result, programs developed with these tools are limited to the physical memory

BYTE ACTION SUMMARY

- **WHAT DOS EXTENDERS ARE**
  Tools for developing DOS applications that run in the protected mode of advanced Intel processors.
- **LIKES**
  Intel and Symantec offer complete development environments, compiler and all; Rational's documentation and tools for both 286 and 386 development are excellent; Phar Lap's 286|DOS-Extender includes an assembler and can create DLLs.
- **DISLIKES**
  Symantec's DOS-extender documentation is weak; Rational and Phar Lap both charge royalties; Intel's compiler documentation assumes familiarity with Microsoft C.
- **RECOMMENDATIONS**
  For developers who need to create DOS, extended DOS, Windows, and OS/2 programs, Symantec's package is the most versatile; Phar Lap's 286|DOS-Extender excels, while Rational's 386 product is the best choice in its class.
- **PRICE**
  Zortech C++, $699.95
  Phar Lap 286|DOS- and 386|DOS-Extender SDKs, $495 each
  Intel 386/486 C Code Builder Kit, $695
  Rational DOS/16M and DOS/4G, $5000 each

I felt at home with the debugger included in the Intel C Code Builder Kit.

available at run time. Phar Lap, however, offers virtual memory management for its 386|DOS package as an extra-cost option.

Linking, Binding, and Royalties

Any executable file generated by these packages is dependent on the functionality of the extender's run-time software. To make running the application convenient, most of the packages let you bind the extender run-time software into the executable file. This results in a much larger executable file but also lets you launch the application more easily. The Symantec, Intel, and Rational products all include bind utilities (although Rational calls it *splicing*), while Phar Lap's utility must be purchased separately.

Rational's Instant-D debugger and Phar Lap's debuggers support the debugging of executable files that are not yet bound, saving the step of binding an executable file before testing it. Intel's debugger accepts only bound executable files.

Phar Lap's 286|DOS-Extender supports the creation of dynamic link libraries, which are executable files that also provide information about the code and data names stored in the EXE file. This lets other executable images make references to functions or data structures in the module without knowing the address of the reference until run time. Rational's extender supports DLLs with an optional segmented executable toolkit, while Intel and Symantec do not offer DLL support for protected-mode DOS programs.

Since the run-time software is most of the DOS extender, vendors traditionally charge royalties for the inclusion of their extenders in your applications. Symantec and Intel, however, let you distribute unlimited copies of your DOS-extended application without additional royalties or fees. Both Phar Lap and Rational require the payment of royalties, and they have

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Debuggers

With the exception of Phar Lap's 286| DOS-Extender, all the products tested here include debuggers. Zortech C++ includes debuggers for Windows, DOS, and OS/2, but it does not let you debug programs generated for its 286 extender. Strangely enough, 386 protected-mode debugging *is* supported.

The 286|DOS-Extender relies on Microsoft's protected-mode CodeView debugger, which is included with the Microsoft C Compiler package. If you have chosen to use the 286|DOS-Extender with a compiler other than Microsoft's, you are left to your own resources to locate an appropriate debugger, although you can purchase the 286|Debug package separately.

The 386|Debug tools in the 386|DOS package have rich features for protected-mode debugging. Among these are several system-level debugging aids, such as commands to show information about the interrupt handler, the status of extended memory, and the local descriptor table and global descriptor table blocks in the processor, and commands to manipulate the DOS Protected Mode Interface. The major flaw of the product is that it does not support source-level debugging. For an additional cost, 286|SRCbug and 386| SRCbug are available to provide source-level debugging.

Being an experienced CodeView user, I felt most at home with the debugger included in the Intel 386/486 C Code Builder Kit. While not as robust as CodeView or the debuggers of any of the other packages reviewed here, it did allow source-level debugging.

I found Instant-D, the debugger included with the Rational products, to be the most powerful of the packages reviewed. It includes an optimization profiler that you can use for performance tuning. The screen shows a display of the current stack frame, which is extremely handy, and it also lets you conveniently step up and down the call chain. To aid system-level debugging, Instant-D includes many commands for checking up on the state of the machine, just as Phar Lap's 386|Debug tool does.

Documentation

Documentation for the Rational products was the most convenient to use; it is housed in three-ring loose-leaf binders and is well written and easy to understand. While the documentation for the Phar Lap tools is split into several volumes, each is littered with useful code fragments.

Intel's package has sparse documentation. The volumes comprehensively detail the differences between the Intel and Microsoft compilers but don't provide good overviews of the compiler or the run-time library for users who aren't accustomed to Microsoft's product. While many rich examples are included on disk, not much documentation accompanies them; you're largely on your own in figuring out how the examples work.

The 286 and 386 extenders in Zortech C++ receive only minimal treatment. A chapter in the reference manuals briefly outlines the functionality and limitations of each extender. Absolutely no treatment is given to the special problems that using an extender creates (e.g., accessing memory-mapped system I/O areas or handling interrupts with protected-mode code).

Overall

Developers who don't already have a compiler and need a general-purpose development environment would probably be best off with Zortech C++. Since this package includes a feature-rich compiler, it can offer something to fit almost every conceivable need, from DOS programming (with or without an extender) to Windows and OS/2 development. Because it supports C++, programmers who prefer an object-oriented environment will also favor it, and C programmers can grow into the object-oriented extensions over time. However, if you're just looking for an extender, you'll be poorly served by this package. 386 developers won't miss the lack of a 286 protected-mode debugger, but the lack of extensive documentation for the extenders thwarts serious efforts.

Intel's package is set back because it doesn't include an assembler, but it was the easiest to install and set up. The compiler readily accepted much of my existing Microsoft C code with only a few changes; it would therefore appeal to those who already have a big investment in Microsoft C code.

Since Phar Lap's 286|DOS-Extender also supports Microsoft C, users who need an assembler might want to pick it over Intel's package. Its more complete documentation is a strong asset, and support for DLLs is a big plus for projects that are code-intensive. Remember, however, that you will have to spend extra for the source-level debugger.

Phar Lap's 386|DOS-Extender SDK is comparable to the DOS/16M extender from Rational. However, because of its support for both Microsoft C and the popular Borland C++, the Phar Lap 286|DOS-Extender SDK is an ideal choice for those who already use these compilers. Its bigger 386-compatible brother, on the other hand, is only usable with one compiler and could call for a great deal of porting work. Assembly language coders will appreciate Phar Lap's assemblers, but Phar Lap's debugger pales in comparison to Rational's elaborate Instant-D.

I thought that Rational's DOS/16M extender had the best documentation of all the packages reviewed here. Documentation provided with the company's DOS/4G package suffered a little, probably because the package is new. The DOS/16M extender supports an impressive list of compilers, but, like Phar Lap's products, the 386 extender supports only two 32-bit compilers. ■

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COMPANY INFORMATION

Intel Corp.
(386/486 C Code Builder Kit)
5200 Northeast Elam Young Pkwy.
Hillsborough, OR 97124
(800) 548-4725
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Phar Lap Software, Inc.
(286|DOS- and 386|DOS-Extender SDKs)
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HARDWARE

The Phaser III Fires Dazzling Colors

TOM THOMPSON

Tektronix's new Phaser III PXi is a standout color printer for a number of reasons. First, the machine uses an advanced ink-jet technology, called *phase change*, that lets you print on plain paper or other media in a wide variety of sizes and thicknesses. Second, print samples from the Phaser III's 300-dot-per-inch output will really catch your eye: The colors almost crackle and glow (thanks in part to the printer's support for Adobe's PostScript Level 2). Finally, the Phaser III's price of $9995 nearly sparkles, too, considering the unit's versatility and output quality.



The new Phaser III color printer from Tektronix. **Inset:** *A close-up view of the color reservoir and its keyed slots that accept the shaped solid ink blocks.*

Meet the Phaser

The printer weighs a hefty 90 pounds and measures 25 inches wide by 27 inches deep by 13½ inches high. Plan on giving it its own table.

Inside, the Phaser III runs an AMD 29000 RISC processor clocked at 24 MHz. The processor powers the PostScript Level 2 interpreter and the Pantone-certified color simulations, and it implements a Hewlett-Packard Graphics Language (HPGL) emulation mode. The Phaser III comes with 10 MB of RAM, upgradable to 18 MB. Its ROMs contain 39 typefaces, including Courier, Helvetica, Times, New Century Schoolbook, and ITC Bookman.

The source of this printer's brilliant color graphics, however, is the phase-change ink-jet technology used to deposit the colors on a variety of paper types that can range from thin tissue to heavy paper stock. This technology uses special, nontoxic, solid inks. These wax-based inks come as sticks that resemble large crayons. Their shapes are keyed, so you can't, for example, accidentally install magenta ink into the yellow color reservoir (see the photo).

Inside the reservoir, heaters liquefy the ink at a temperature of 140 °C. When the Phaser III begins printing, the print head travels back and forth, spraying colored ink droplets onto the paper at 300 dpi. At room temperature, these droplets instantly solidify. Two rollers then cold-pressure-fuse the inks over the paper's surface. (For more information on this process, see "Ink Jet Takes Off," October 1991 BYTE.)

Connections and Other Features

On the outside, the Phaser III sports the usual bevy of I/O ports and indicators. There's a mini-DIN-8 LocalTalk port (whose driver, unfortunately, supports only AppleTalk Phase 1), a DB-25 serial port, a Centronics-style parallel port, and a 50-pin Centronics-style SCSI port. This latter port handles SCSI hard drives for font caching. The Phaser III's firmware automatically detects and spools data from the LocalTalk, serial, and parallel ports so that different computers can share the printer. However, the Phaser III doesn't automatically toggle back and forth between PostScript and HPGL modes; you have to do that manually from the front panel.

The front panel includes a small LCD screen that serves several functions. During a print job, it informs you about the printer's activity (e.g., warming up, imaging page, or initializing). The panel notifies you of a print jam and where it occurred. Finally, it provides a rough indicator of each ink level in the reservoir. By using two front-panel buttons, you can change the language used by the display from English to French, German, Japanese, Italian, or Spanish.

To set up the printer, you power up the unit, drop the four ink sticks (cyan, magenta, yellow, and black) into the keyed openings, throw a lever to drop the inks into the reservoir, and wait for the printer to warm up. The warm-up time is about 15 to 20 minutes, so you definitely want to leave the Phaser III switched on. To conserve power, the printer goes into a standby mode if it sits idle for 2 hours.

continued

BYTE ACTION SUMMARY

■ **WHAT THE PHASER III PXI IS**
A PostScript Level 2 color ink-jet printer with a 300-dpi resolution that prints solid inks on plain paper and other media.

■ **LIKES**
Solid ink technology is easy to use and works with standard paper; the printer can handle a variety of paper stocks and sizes. The superb color output is a standout among color printing technologies.

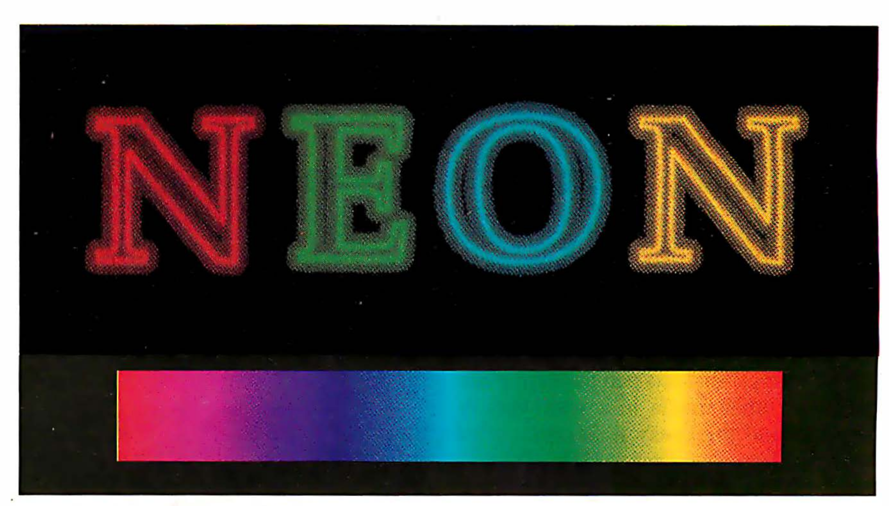
■ **DISLIKES**
The printer is big, heavy, and slow.

■ **RECOMMENDATIONS**
This is a winner for those who need bright colors, work with different-size output, and want to keep printing costs low.

■ **PRICE**
$9995 for a standard 10-MB configuration; memory is expandable to 14 or 18 MB for $995 per 4-MB increment.

■ **FOR MORE INFORMATION**
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Sample output from the Tektronix Phaser III PXi printer. Notice the rich, saturated blacks in the NEON *output. The rainbow bar shows the wide color range that the Phaser III is capable of producing.*

An incoming job kicks the Phaser III back into operating mode after a delay of about 2½ minutes to warm the ink and clean the print head.

The Phaser III can handle practically any paper stock and a variety of sizes. The printer's standard 10 MB of RAM lets you print on letter-size pages from A-size (8½- by 11-inch) up to B-size (American tabloid, 11- by 17-inch) sheets. With a 4-MB expansion added, you can print on A3-size (Metric tabloid, 297- by 420-mm) sheets.

The standard paper tray handles American type A (8½- by 11-inch) or Metric type A4 (210- by 297-mm) sheets, while an optional universal tray handles A-, legal- (8½- by 14-inch), B-, A4-, and A3-size paper. By manually feeding the paper into a slot on the printer's top, you can print from postcard-size (4- by 6-inch) to Tabloid-extra (12- by 18-inch) sheets. You can also print on a variety of papers, including gummed labels and stickers.

Trial Run

The printer comes with software drivers for both Macs and PCs. On the Mac, a Chooser-selectable, System 7.0–compatible driver is provided, along with support files for background printing. On the PC, there are PostScript drivers for Windows 3.0, Lotus 1-2-3, and Lotus Freelance.

I used a Mac IIfx with 8 MB of RAM and equipped with an 8•24 GC display board and an 80-MB hard drive for the printing tests. I printed a mixture of PostScript graphics and 24-bit scanned images, the latter of which can point out dithering problems. I used Adobe's Illustrator 3.0 and Photoshop 2.0 for my application tests and CE Software's Widgets to download PostScript code.

The bad news is that the Phaser III is slow. There are two reasons for this. First, the LocalTalk network connection that I used is slow. At 230,000 bps, multimegabyte 24-bit images take time to trickle to the printer.

The other delay is due to the print head, which takes time to traverse the paper. The traveling print head sounds like a car's windshield wiper on a rainy day, and the printer is quite energetic about moving it: Occasionally, the lab bench vibrated in time with the head's shuttling. In standard mode, a letter-size sheet of paper took 2½ minutes to print. At higher-quality modes, the print job took longer, using about 4 minutes in enhanced mode and nearly 7 minutes in premium mode to print a page.

Despite the delay, the results were gorgeous: Colors were rich, which made the output glow (see the figure). Using the Phaser III driver, the blacks were crisp and opaque, with a minimum of color-dithering artifacts. Because of the dithering process, blue tones can appear purple on PostScript graphics, but a blue correction option in the printer driver fixes this. I even got brave and printed some logos on some laser printer labels without problems, although I had to use the premium mode to get enough ink onto the labels.

Who Needs It?

Some folks like the translucent glow of thermal wax output, but such printers require specially coated paper. This drives the cost of thermal wax prints up to 45 to 50 cents per page. Personally, I liked the Phaser III's bright, snappy colors. For printing on 30 percent of a letter page's surface, the Phaser III's operating costs are 25 cents per page. Naturally, covering more of the sheet with ink or printing on larger pages ups the costs.

Who needs this printer? Anyone who wants to print on plain paper, thin sheets, thick stock, cards, or labels should consider the Phaser III PXi. The added bonus, of course, is that the Phaser III's bold colors will make your artwork stand out from the crowd. ■

Tom Thompson is a BYTE senior technical editor at large. He has a B.S.E.E. degree from Memphis State University. He can be contacted on BIX as "tom_thompson."

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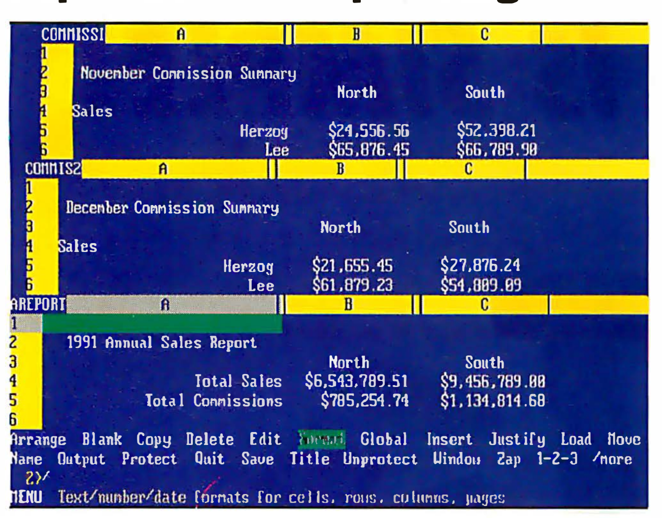
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SuperCalc Gets Supercharged



Screen 1: *CA-SuperCalc 5.1 retains the stacked worksheet view of SuperCalc 5 but is faster and offers better 3-D support.*

Computer Associates International has sharpened up its popular SuperCalc 5 spreadsheet in preparation for further jousting with Lotus 1-2-3 for DOS spreadsheet dominance. CA-SuperCalc 5.1, the latest release, addresses many weaknesses of SuperCalc 5, and at $149 it offers an attractive alternative for users interested in an inexpensive DOS spreadsheet.

SuperCalc 5 gained some success, but it was hampered by slow performance, inefficient memory usage, and less sophisticated three-dimensional manipulation than some of its competitors (see "Not Just for Numbers Anymore," February 1990 BYTE). CA-SuperCalc 5.1 includes enhancements in all these areas, and it makes for a considerably stronger package.

CA-SuperCalc 5.1 is a text-based DOS spreadsheet in the mold of Lotus 1-2-3. You can enter data, text, and formulas into the worksheet area and use a slash command to get to a hierarchical menu. The hierarchical structure is very different from that of 1-2-3, but once you get used to the organization, the menus are easy enough to follow. If you are a die-hard 1-2-3 user, you can enter commands using 1-2-3 syntax. CA-SuperCalc 5.1 reads 1-2-3 macros as well as data files.

Like Lotus 1-2-3 release 3.1, CA-SuperCalc supports a 3-D spreadsheet model. Spreadsheets can be single worksheets, or they can include a collection of stacked sheets or pages (see screen 1). With a multipage spreadsheet, you can work with 3-D ranges—that is, you not only specify ranges with horizontal and vertical borders, but you also specify which pages of the stack of spreadsheets are to be included. Three-dimensional capability is most useful for collecting data across similar sheets. For example, you could set up a collection of monthly reports in a single multipage spreadsheet and use 3-D ranges to create an annual summary. Besides multiple pages, CA-SuperCalc also supports links to other spreadsheets in memory or on disk.

The most significant enhancements to CA-SuperCalc 5.1 are better performance and a more natural 3-D model. BYTE's spreadsheet benchmarks demonstrate the marked improvement between SuperCalc 5 and the newer release (see the table). Most striking is the improvement in simple calculation speed, as demonstrated by the Mathmix benchmark. CA-SuperCalc 5.1 not only beat SuperCalc 5 by a wide margin but also slightly outdid Lotus 1-2-3 release 2.3.

Floating-point calculation speed, measured by the Savage benchmark, and database sorts also show improvement. On these tests, however, CA-SuperCalc 5.1 still falls short of overcoming 1-2-3.

There is less differentiation between 2-D and 3-D ranges in version 5.1 than there was in previous versions. This leads to a more natural extension of formulas and ranges into the "depth" dimension. For example, you can now copy relative page references, whereas page references were always absolute in SuperCalc 5.

CA-SuperCalc 5.1 retains the same strong graphics and reporting capability of its predecessor; you can generate and annotate 3-D graphs and control fonts and shading on reports. However, you still can't embed graphics in reports or see WYSIWIG previews.

This updated version of SuperCalc is a genuine improvement over its predecessor and a worthy contender for those considering a new DOS spreadsheet.

BYTE SPREADSHEET BENCHMARKS

Computer Associates' updated CA-SuperCalc 5.1 shows vast performance improvement compared to the older SuperCalc 5, but it falls short of Lotus 1-2-3 release 2.3. All times are in seconds.

	Savage	Mathmix	Sort
CA-SuperCalc 5.1	52	1	77
SuperCalc 5	64	22	108
Lotus 1-2-3 release 2.3	26	2	34

A New Weapon to Fight Jaggies



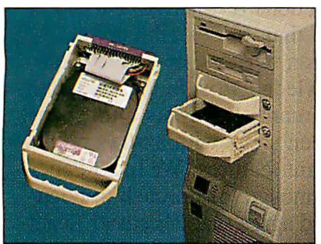
Screen 2: *Although JAG does a good job of antialiasing jagged curves, such as those on the B, it also smoothes the ascenders and descenders of large sans serif type. Consequently, the base of the Y tapered at the corners and looked worse than before we ran JAG.*

JAG, from Ray Dream, gives Macintosh-based graphics professionals an easy way to antialias gray-scale and color PICT or PICS images. An acronym for "jaggies are gone," JAG adds gray tones or colors to image and text edges. As a result, the eye sees smoother lines instead of the rough stair steps in images created in paint packages, rendered 3-D

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objects, or animations.

Among JAG's more appealing features is its simplicity. Once you transfer the program to the System Folder, you open a suitable file and choose the antialias selection from the menu, and JAG performs its duty. Alternatively, a menu selection lets you choose whether or not to antialias single-pixel-thick lines. This choice is important, we found when we tested images with small text. Antialiased small type looked bleary and less readable than before it received JAG's treatment. You can also choose to let JAG ignore single-pixel points of color. Otherwise, intended design elements or dots above an *i* would disappear into an antialiased background.

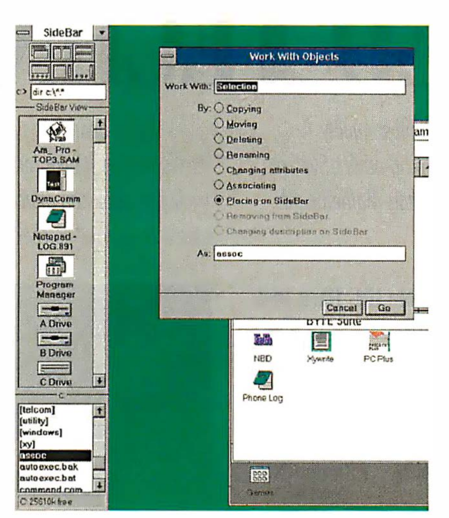
In our tests using a Mac IIfx and a Mac II, JAG performed at a snappy pace. For example, JAG antialiased a 72-KB PICT file in approximately 37 seconds on the IIfx. Using the program's batch queue option, we easily antialiased a presentation consisting of 10 frames, which we created in More 3.0. Similarly, we used JAG to "clean up" a short PICS file consisting of animated text. JAG allowed us to antialias the individual frames as a batch in the background.

In the end, we found ourselves ambivalent about JAG's results, primarily because JAG didn't know when to leave well enough alone. It did a fine job of smoothing the jagged edges around curves in text and images. Unfortunately, the program also decided to smooth the right angles on the ascenders and descenders of large sans serif type. Consequently, the base of a capital *Y* tapered at the corners and looked worse than before we ran JAG (see screen 2). Ray Dream says a future version of JAG, which should ship late in the first quarter, will include a lasso that will let you select only the areas that need sprucing up.

JAG's quickness can make it a handy utility, especially if your 3-D graphics package takes forever to simultaneously render and antialias an image. Just keep in mind that questionable quality can be the trade-off for expediency.

A SideBar for Windows

When we have files to rename or directories to create, we'd rather switch to a DOS shell than fight the Windows file manager. But shelling to DOS is a time-consuming process that makes simple file operations more tedious than they need to be. SideBar, a $99.99 organization tool for the Windows desktop, has made the Windows environment a much more pleasant place to spend the day.



Screen 3: *SideBar combines file management and program management tools behind a slick interface.*

SideBar is a narrow window that sits on one edge of the Windows desktop. It combines file and application management tools in one accessible box (see screen 3). SideBar has many functions, but there are two primary components: a command line and a collection of drive and applications icons. The SideBar command line is a small window near the top of the tool bar. You type in commands such as `dir c:\*.com` or `copy foo.txt bar.txt`, and SideBar responds by bringing up a dialog box with which you can confirm or modify your command. Having a simple command line inside Windows is incredibly useful; it's difficult to imagine how much trouble this saves until you've tried it.

The second component is the icon bar, which contains icons for applications and icons representing disk drives. Applications icons can represent currently active tasks (SideBar replaces the collection of minimized task icons that Windows would normally display in the lower left corner of a screen) or startable tasks that you select. Clicking on applications icons switches to or launches the selection, as appropriate.

Clicking on drive icons displays file lists for that drive. You can split the bar vertically, or horizontally as it is in the photo, to get access to more than one drive or directory. By clicking, dragging, and dropping selections, you can copy, move, or delete files using the icon bar. SideBar can replace the task manager; however, we found that having SideBar in addition to the standard windows task management tools was most useful. SideBar also lets you select items from program groups by clicking on the desktop.

Many functions of SideBar are much easier to use than to describe textually. Documentation writers at Paper Software acknowledge this in the SideBar manual; the manual consists almost entirely of screen shots with arrows pointing out relevant features. We liked Paper Software's innovative approach to documentation and agree that it's easier to get through than the standard sea of text.

We found SideBar to be a very handy utility that improves life within the Windows environment. If you need a new file management tool but don't need (and can't afford) all the accessories in shell replacements like the Norton Desktop for Windows, give SideBar a try. ■

—The BYTE Lab

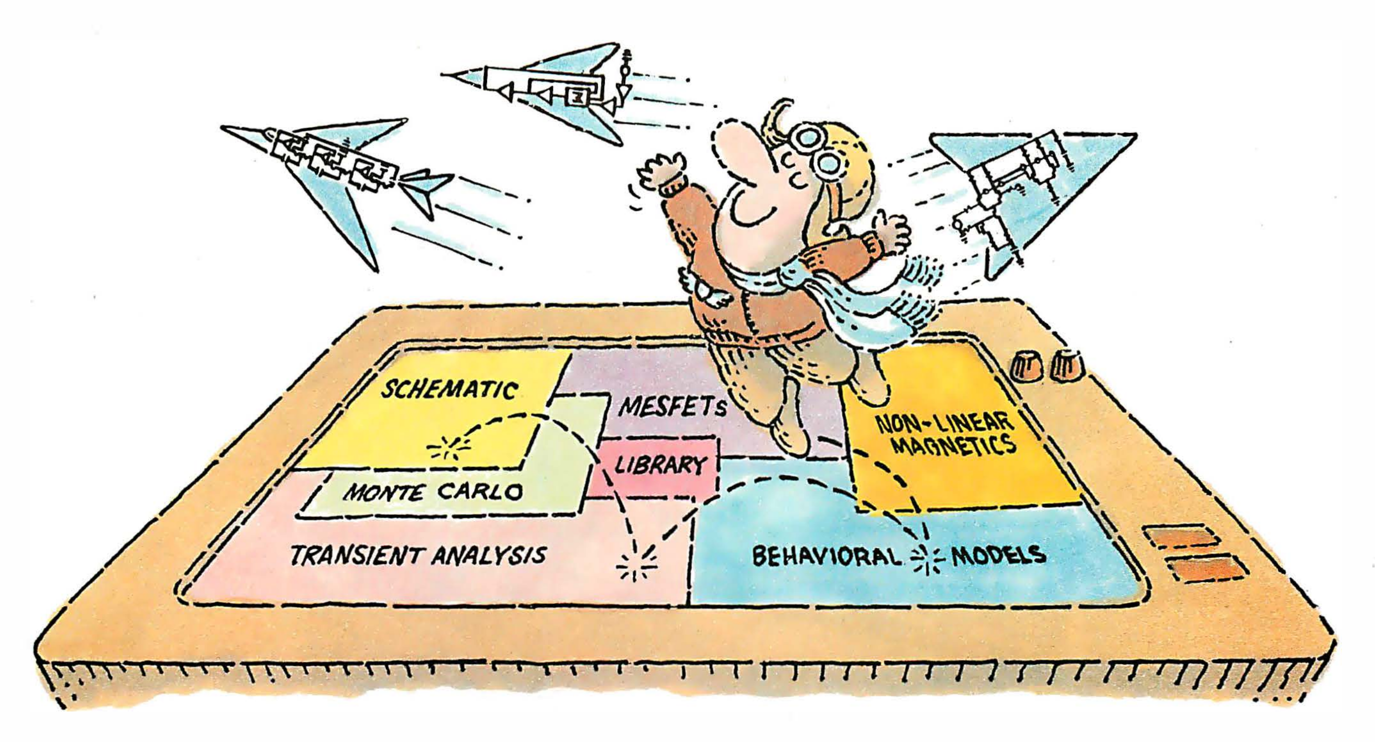
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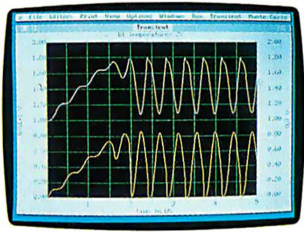
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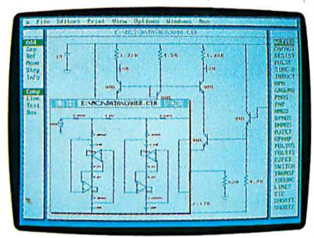
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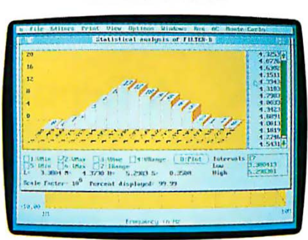
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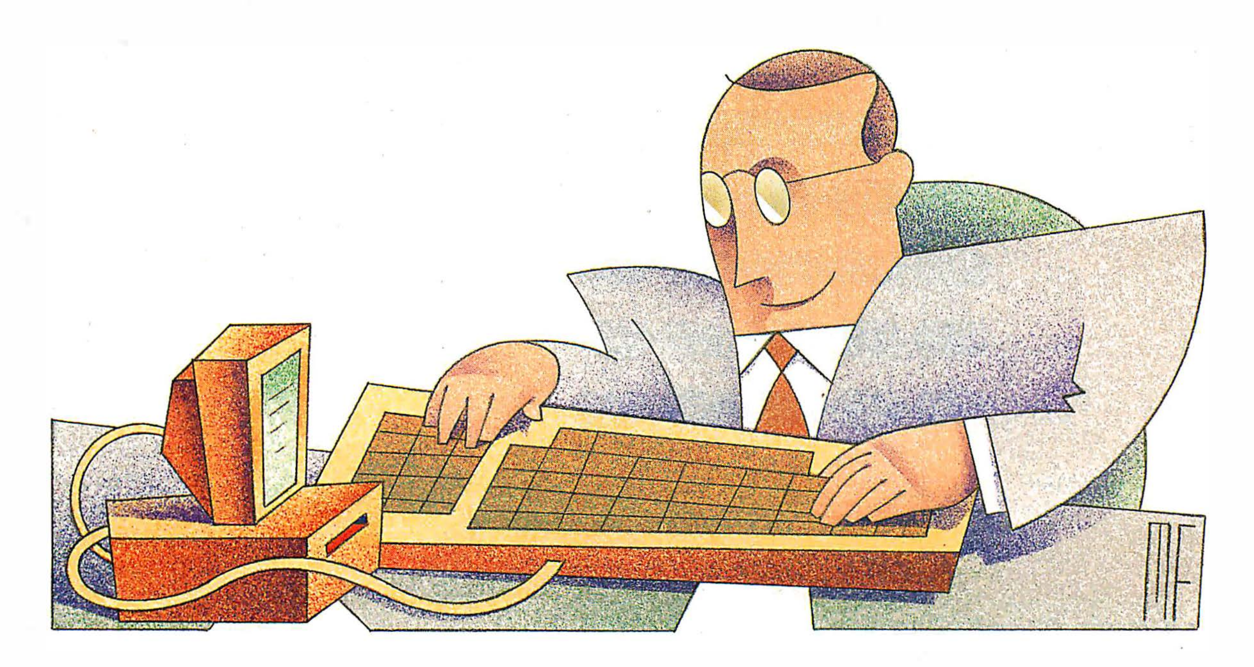


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FINALLY, A REAL KEYBOARD



A LapLink cable and your desktop's printer port can take the place of a cramped laptop keyboard

If you asked me to name the two most inconvenient things about modern notebook computers, I'd have to say their short battery life and cramped, shrunken keyboards. There's not much we can do about the batteries just yet—that will come in time. In the meantime, however, any time you have your notebook machine near your desk, why not use your desktop computer's keyboard as a substitute? You've probably got everything you need to do the job.

The Versatile Printer Port

Most of the newer notebook machines leave off I/O ports to save space. Few, if any, include an external keyboard connector anymore, and it's simply not possible to use any other port to drive a keyboard, since a standard PC keyboard uses a clocked serial I/O stream to move data to and from the keyboard.

However, the printer port, with 8 bits of data out and 5 bits of data in, is an incredibly versatile beast. When the port is connected to a printer, the 8 output bits are used for the printed characters. Five other control bits take care of handshaking and control functions. The 5 input bits handle handshaking and status. (See the table.) The ROM BIOS has the responsibility of manipulating these bits to make the printer port talk to a parallel printer. But if you write your own software, you can make the port do just about anything you want.

In my case, I was tired of dealing with scrawny little notebook keyboards. Part of developing the notebook battery-life tests (see "Notebook Power Management at Its Zenith," December 1991 BYTE) included sending status information between a host computer and the notebook under test. The machines were linked through the notebook's printer port. With luck and some assembly code, I created a TSR program for the notebook that accepts keystroke information from the desktop machine and posts it in the notebook's keyboard buffer. A companion utility for the desktop machine accepts keystrokes and passes them through the parallel cable.

Let's Talk Keystrokes

The printer port communications is only one part of the project—I'll get to that in a minute. First, here's a brief refresher course on the keyboard.

In a PC, the keyboard is linked through dedicated hardware (in a PC or XT) or a microprocessor (AT). Either way, when a key is pressed, a hardware interrupt occurs. BIOS Int 9 hexadecimal (whose vector is stored at location 0000:0024) fields the interrupt, looks at the incoming scan code, and decides what it means. If it's a Shift/Ctrl/Alt key, the BIOS just stores the key's status. Most likely, though, the keystroke will be a character key. A lookup table in the BIOS ROM contains every

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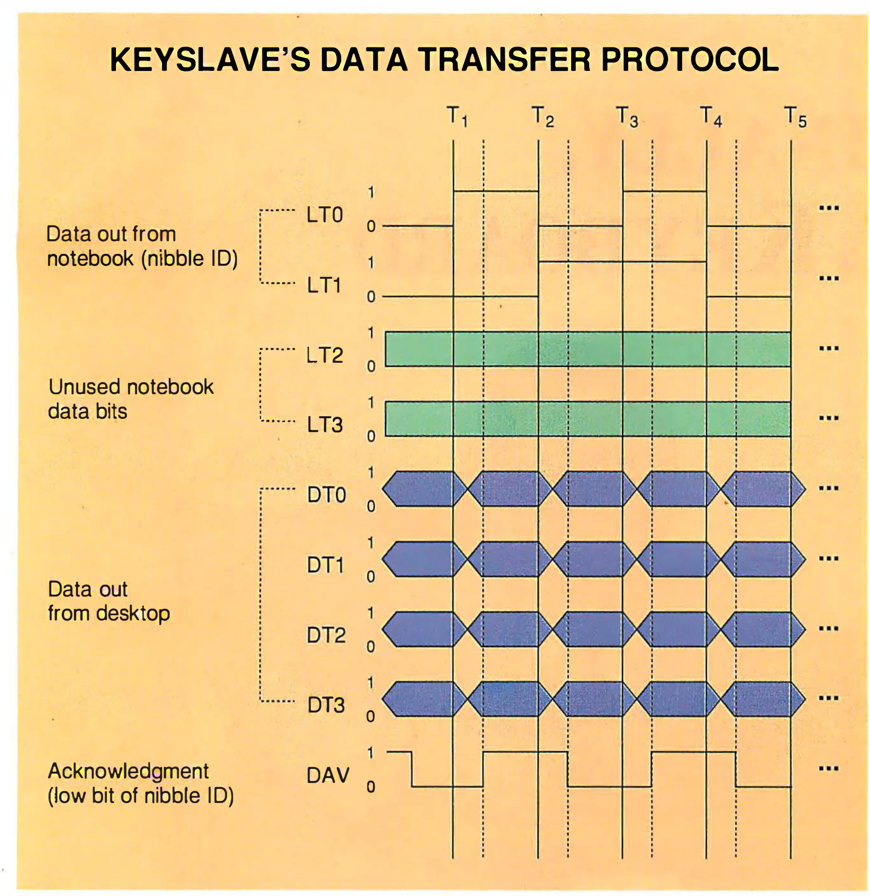


Figure 1: *To begin a transfer, the notebook sets its 2 data bits (LT0 and LT1) to 0 to request the first data nibble (nibble ID value). Some time later, the desktop recognizes a new request and places the data on four of its output lines. Taking a copy of the nibble ID's least-significant bit (in this case, a 0) and placing it on the fifth data line tells the notebook that the data is ready. At the next notebook clock tick (T1), the notebook sees the LSB and gathers up the data bits. After storing the 4 bits of data in memory, the notebook requests nibble 1 and returns to the application. The cycle continues until the notebook takes in the last nibble at time = T4.*

possible keystroke and a corresponding ASCII value. The BIOS searches through the table, finds the appropriate ASCII value, and places the value and key-scan code in the BIOS data area. Later, your application or DOS itself makes a BIOS call (Int 16h) to retrieve the keyboard data.

One approach to extending the notebook's keyboard might have been to send the raw scan codes from the desktop and perform the lookup function on the notebook, but that seemed like a lot of unnecessary work. The desktop's BIOS does the same thing, so I decided to have the desktop send the completed keyboard buffer data and have the notebook simply store the data in its own buffer. The more you mess with hardware interrupts on a PC, the more trouble you're asking for, so I opted to take the safe way out and simply intercept Int 16h.

You Can't Always Get What You Want

The next piece of the puzzle was getting the data from the desktop to the notebook through the printer port. It would have been heaven to have enough bits to move all 16 data bits (8 bits of ASCII and 8 bits of scan code) in one fell swoop, but it wasn't to be. The desktop can send out the 16 bits as two groups of 8, but the notebook can only receive them 5 bits at a time. Besides, there has to be some kind of synchronization between the two machines to ensure that the data made it from one to the other.

Using 4 of the notebook's 5 input bits for data and the fifth bit for control seemed the obvious solution. Traveling Software's LapLink cable is set up to transfer data that way. Inside the parallel cable, bits 0 to 4 of the desktop's data are connected to the notebook's 5 status bits.

PC PRINTER PORT

Depending on the hardware configuration, the base address of the printer port will be one of three values. On most systems with color monitors, the first printer (LPT1) will have a base address of 378h, and LPT2's base address will be 278h. On some color machines and all machines with monochrome ports, LPT1 will reside at 3BCh.

OUTPUT BITS

Address	Bit no.	DB-25 pin	Original function
Base	0	2	LSB data out
	1	3	Data out
	2	4	Data out
	3	5	Data out
	4	6	Data out
	5	7	Data out
	6	8	Data out
	7	9	MSB data out
Base+2	0	1	Data strobe
	1	14	Auto linefeed
	2	16	Initialize printer
	3	17	Activate select
	4		IRQ enable

INPUT BITS

Address	Bit no.	DB-25 pin	Original function
Base+1	3	15	Error status
	4	13	Selected
	5	12	Out of paper
	6	10	Data acknowledged
	7	11	Busy

Bits 0 to 4 from the notebook are connected to the desktop's status bits. Any data output from one machine appears as printer status on the other, shifted to the 5 highest bits on the status port.

Moving 16 bits of data 4 bits at a time requires a bit of protocol. I chose a simple protocol that transfers 1 nibble (4 bits) of data per transfer cycle. Figure 1 shows the timing and data flow between the machines. The notebook is in control of the data flow and refers to the 16-bit value as a sequence of nibbles, numbered 0 to 3.

To begin a transfer, the notebook asks for nibble 0 by putting a 0 on its output port (LT0 or LT1). The desktop machine sees this as a change from the previous

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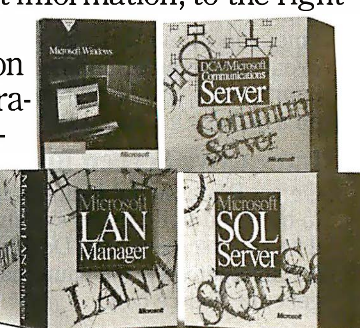
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Listing 1: *The desktop computer's data transmission routine. PORTIN transfers a byte of data from the desktop's status port. To acknowledge and respond to a request from the notebook, isolate the three nibble ID bits. Use the ID to determine which of the four nibbles you want, isolate them, and send them out the data port. You'll know the data was received when the notebook asks for another nibble.*

```
sc_1:
; See which nibble they want
   call  PORTIN
; value in bits 3-5
   and   al,00111000b
   shr   al,1
   shr   al,1
   shr   al,1
   mov   ch,al      ; ch holds the nibble ID
      .
      .
      .
   shl   al,1
   shl   al,1
; We're going to rotate the bits 0, 4, 8, or 12 bits to
; the right. Multiply the number in AL by 4 and shift
; the contents of BX that many bits.
   mov   cl,al
   mov   ax,bx
   ror   ax,cl
   and   ax,000fh
; shift it back to the left to make room for the nibble ID
   rol   ax,1
; Now to that, add in the low bit of the nibble ID as
; bit 0.
   mov   ah,ch
   and   ah,1
   or    al,ah
   call  PORTOUT
sc_2:
; Wait for them to ask for a different one
   call  PORTIN
; value in bits 3-5
   mov   ah,al
   and   al,00111000b
   shr   al,1
   shr   al,1
   shr   al,1
   cmp   al,ch
   je    sc_2
; If we sent nibble 3, stop sending
   cmp ch,3
   jne sc_1
sc_out:
```

value, isolates nibble 0 from the data, and puts its value on its data port (DT0 through DT3). The notebook needs a signal of some sort, so the desktop uses the low bit of the nibble select as an indicator (data valid, or DAV). On the next clock cycle, the notebook sees that DAV has changed, grabs the data from its status port, and sets LT to the next nibble. After the desktop successfully transfers the third nibble, it waits for another key from the keyboard and repeats the process.

Stay Away from the Clock!

The desktop has nothing else to do during a transfer, so it polls the printer port looking for the data to change. The notebook doesn't have that luxury—after all, the point of this exercise is to let the notebook run normal DOS software from the remote keyboard. Fortunately, when it comes to clocks, the PC is a funhouse.

Every PC has a hardware clock built onto the motherboard. An Intel 8253 timer chip provides three channels of continuous, programmable time clocks. One channel is wired to the memory refresh; playing with that channel is certain death. The second is tied to the PC's speaker, letting the speaker make tones independently of the processor's clock speed. This channel is not only popular with application programs, it's difficult to read—so we'll pass on that one, too.

The last channel is programmed by the BIOS to a steady 18.2 ticks per second and feeds the DOS software time-of-day clock as well as the floppy BIOS. During normal operation, a tick comes in each $\frac{1}{18}$ second. A hardware interrupt (Int 08h) takes over and updates internal counters and the DOS time-of-day clock. It next transfers control to the user clock routine at Int 1Ch and then returns to the foreground program. The BIOS monitors these ticks to provide a stable time source for the floppy disk software. This is an important clock, but you can use it if you're careful. The easiest way is simply to key off the user clock interrupt, 1Ch.

Transferring a keystroke from the desktop requires four clock events. If each one takes $\frac{1}{18}$ second, it will take $\frac{4}{18}$, or $\frac{1}{4}$, second for each keystroke. I don't know about you, but I can type a lot faster than that. I think we can do better than this, but it may help to see how the notebook handles the incoming data first.

Transfer Across State Lines

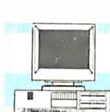
Unlike the desktop machine, the notebook has to be free to run other applications. The protocol software on the notebook must run as an interrupt-driven process, timed by the PC's hardware clock. On each clock tick, the software takes control, checks to see if there's something to do, and then exits back to the foreground application.

If the notebook decides that the desktop has responded to its previous request, it grabs the nibble into memory. If this was one of the first three nibbles, you ask for the next one in sequence. After grabbing the fourth (and last) nibble, it checks to see if there's room in the keyboard buffer to store it. If there is, it stores the completed keystroke in the buffer and asks for the first nibble of the next keystroke. If there isn't, it simply exits and waits for the next clock tick to check again. The desktop will wait patiently, forever if necessary, for the next request. (See listing 1.)

A simple state machine forms the heart of the notebook software. Listing 2 shows a hacked-up version of the state machine, with the innards removed for clarity. On each clock tick, the appropriate code is executed for the current state.

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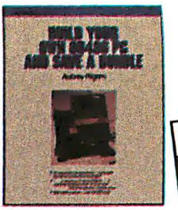
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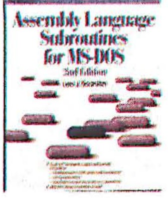


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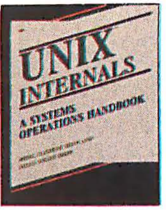
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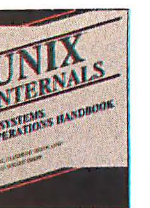


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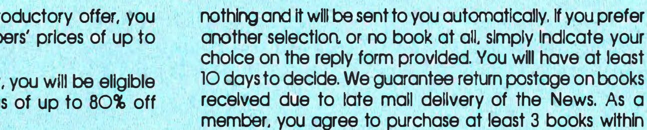
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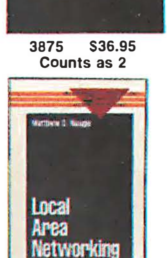
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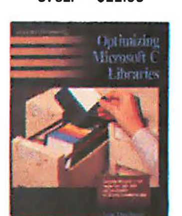
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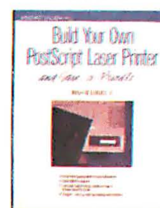
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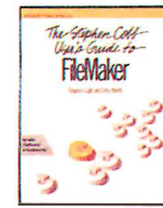
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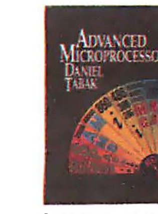
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Listing 2: *The notebook's state machine. Every time the clock-tick interrupt occurs (72 times per second), control is transferred to the state machine. Depending on where the algorithm left off, deal with one of the four incoming nibbles. If successful, set up for the next one; if not, keep the state the same and try again next time. The maximum transfer rate is 1 nibble every tick, or one complete keystroke every 4 ticks (18 per second).*

```
state_curr db ?
state_table dw ST_0,ST_1,ST_2,ST_3,ST_4
   .
   .
   .
   mov   bl,state_curr   ; grab the current state
   mov   bh,0
   shl   bx,1
   add   bx,offset state_table
   jmp   [bx]
ST_0:
; see if nibble 0 is available
   mov   al,0
   or    al,Keyb_status
   call  PORTOUT
   call  PORTIN
; if the data return bit is the same as the low bit of
; the address (in this case, a 0), then the data is valid
   mov   ah,al           ; make a copy
   and   al,Nibble_ret
   jnz   int_out         ; not yet
ST_0a:
; The data is the high bits of AH, adjusted
   and   ah,Data_mask
   xor   ah,Data_adj
   shr   ah,1
   shr   ah,1
   shr   ah,1
   shr   ah,1
   mov   al,ah
   xor   ah,ah           ; AX is 0, except the low nibble
   mov   Input_data,ax
   inc   state_curr
   mov   al,1
   or    al,Keyb_status
   call  PORTOUT
   jmp   int_out
ST_1:
; see if nibble 1 is available
   mov   al,1
   or    al,Keyb_status
   call  PORTOUT
   call  PORTIN
; if the data return bit is the same as the low bit of
; the address (in this case, a 1), then the data is valid
   mov   ah,al           ; make a copy
   and   al,Nibble_ret
   jz    int_out         ; not yet
ST_1a:
; The data is the high bits of AH, adjusted
   .
   .
   .
   jmp int_out
ST_2:
; see if nibble 2 is available
   mov   al,2
   or    al,Keyb_status
   call  PORTOUT
   call  PORTIN
   .
   .
   .
ST_3:
; see if nibble 3 is available
   .
   .
   .
; That's the last one. Store it.
; The data is the high bits of AH, adjusted
   and   ah,Data_mask
   xor   ah,Data_adj
   mov   bh,ah
   xor   bl,bl
   mov   ax,Input_data
   add   ax,bx
   mov   Input_data,ax
   mov   state_curr,4    ; in case the buffer's full
ST_4:
; output it
   call  store_buffer
; If al=0, no problem. If al=1, then buffer was full.
   cmp   al,0
   jne   int_out         ; couldn't save it
   mov   state_curr,al   ; back to state 0
   or    al,Keyb_status
   call PORTOUT
int_out:
```

The first state clears a 16-bit word and stores the nibble as the lowest-order bits. States 1 and 2 store the data in the correct positions. State 3 stores the final nibble and then tries to place the completed data in the keyboard buffer. If there's room, it resets back to state 0. If not, it goes to state 4, which simply retries the buffer on the next tick. As long as the buffer remains full, the state remains at 4 and the transfer is stopped.

Keyboard Buffers

In listing 2, `store_buffer` is a routine that handles getting the data into the keyboard buffer. On machines with a PS/2-compatible BIOS, that's simply a matter of calling the BIOS keyboard-stuffing function. Int 16h, function 5, takes a 16-bit scan-code/ASCII pair and places it as the last item in the keyboard buffer, as if it were typed.

Using the BIOS function is the preferred method because you don't have to know any machine-specific addresses. On many machines built before 1988, the BIOS doesn't have a clue what function 5 is. To store data in the keyboard buffer on these machines, you have to do it the hard way: You have to duplicate the code that the BIOS uses in its own keyboard hardware handler (Int 9h). If you have trouble getting this to work, you might try disassembling the BIOS handler.

Figure 2 shows the keyboard's buffering scheme. Somewhere in the 0040 segment, there's 16 words of memory reserved for storing keyboard information. Normally, BIOS Int 9h puts its keystrokes there so you can read them back through Int 16h. You're not supposed to access the buffer directly. For one thing, you can't assume that you know where it is—that varies from BIOS to BIOS. Also, programs that expand the keyboard buffer will replace this whole scheme with something else—maybe. If you play with the keyboard buffer and then crash the

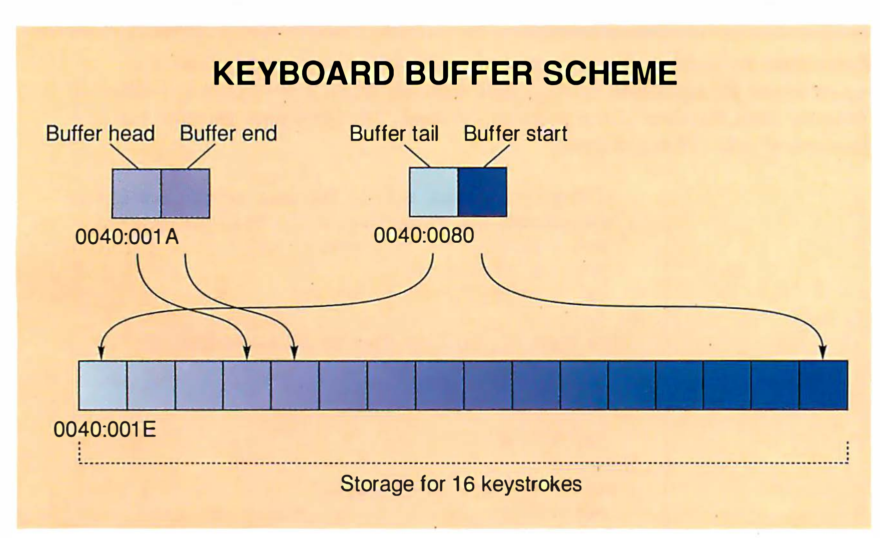


Figure 2: *The keyboard buffer has storage for 16 keystrokes, two pointers to the head and tail of a circular buffer, and two more pointers that determine the physical buffer boundaries. The ROM BIOS normally handles the buffer stuffing as part of the keyboard hardware interrupt, but you need to do it yourself if you're running on an old machine. Newer BIOSes have function calls to place data in the buffer.*

Listing 3: *Stuffing data into the keyboard buffer. First, use* [buffer_tail] *to find the next empty location. Then* [buffer_start] *and* [buffer_end] *tell you where the buffer boundaries are, unless this is a weird machine (assume standard values). Finally, store the data if there's room, and advance* [buffer_tail].

```
; Scan code/ascii char in DX is to be stored in the keyboard buffer
; Returns: AL=0 if OK, AL=1 if buffer full
   mov   ax,40h       ; keyboard data in segment 40
   mov   es,ax
   mov   di,es:[buffer_tail]
   mov   bx,di        ; this is where we'll store to
   add   di,2         ; point to next location
   mov   ax,es:[buffer_end]
; Some machines don't store the buffer start/end in [80],[82h]
   cmp   ax,0
   jne   sb_0
; For example, this one! Is this an old Compaq?
   mov   ax,3eh ; the 'standard' buffer_end
sb_0:
   cmp   di,ax
   jne   sb_nowrap
   mov   di,es:[buffer_start]
   cmp   di,0         ; legit _start?
   jne   sb_nowrap    ; looks like it
   mov   di,1eh       ; the 'standard' buffer_start
sb_nowrap:
   mov   ax,es:[buffer_head]
   cmp   ax,di        ; If =, then no more room
   je    sb_err
   mov   es:[bx],dx
   mov   es:[buffer_tail],di
   mov   al,0
   jmp   short sb_out
sb_err:
   mov   al,1
sb_out:
; Note--this is the equivalent of the following:
   mov   ah,5
   int   16h
```

machine, don't say I didn't warn you.

In addition to the 16-word buffer, 4 other words define where the buffer lives and its current status. Two words starting at 0040:001A are the `buffer head` and the `buffer tail`. The `buffer head` points to the next available word of keyboard data. The `buffer tail` points to the next empty spot. To find out where the buffer physically starts and ends in memory, look in locations 0040:0080 and 0040:0082 for `buffer start` and `buffer end`.

The idea behind buffer stuffing is this: Check to see if the buffer has room for new characters. If so, store the data and advance the tail pointer, using the start and end pointers to handle wraparound. Listing 3 shows the process. Take care to disable interrupts while you're messing with the keyboard buffer; if someone presses a key on the keyboard while you are doing it—well, it won't be pretty.

The next thing to consider is what happens if someone tries to print from within an application while you're slamming on the printer port. You've got data coming in on the printer status bits, and you don't want any applications sending data out or interpreting your incoming data as printer status. The easiest way to avoid this is to install a new printer BIOS routine—one that eats any attempts to print. KEYSLAVE.ASM uses a simple one that flushes any calls to the printer BIOS (Int 17h) and reports the call as successful.

The Funhouse Closes at Midnight

Earlier, I said that the system clock runs at 18.2 ticks per second. That seems an odd number, but it makes sense if you consider how the clock hardware works.

The 8253 timer is fed off a 1.19-MHz crystal, regardless of the CPU speed of the machine. For each of the three timers (remember the speaker and memory refresh), you give the 8253 a divisor. A divisor of 1 divides the clock by 1 and generates a signal at 1.19 MHz. The maximum divisor is 65,536, which generates an 18.2-Hz signal. The BIOS is coded in ROM to expect a signal at that rate. Changing it is easy, but that makes the DOS time-of-day clock go bonkers and freaks out the floppy disk BIOS software. If you're going to change it, you have to take that into account.

If you want to speed up the clock, simply set a different divisor in the 8253's registers and do something about the BIOS. Say you want to speed up the clock by a factor of 4. Instead of using 65,536 as your divisor, use 16,384. That will make the clock run four times as fast and confuse the BIOS beyond belief.

continued

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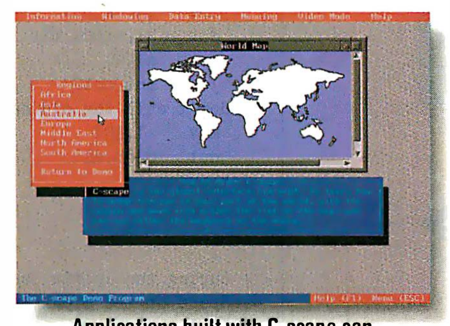
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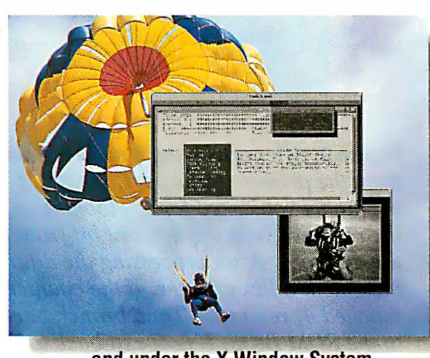


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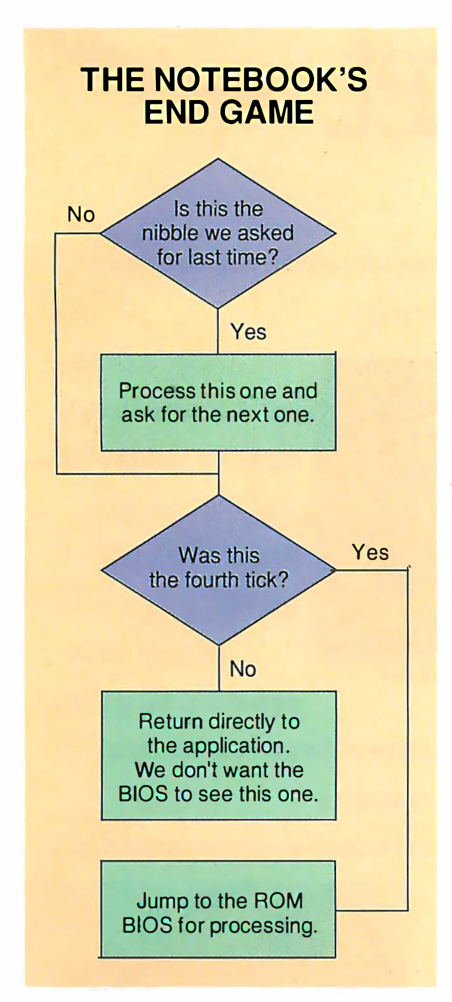


Figure 3: *After retrieving a nibble of data from the printer status port, see if it's the nibble you asked for (by looking at the returned least-significant bit from the desktop). After processing the data, increment a tick counter. If the counter reached 4, reset it to 0 and branch back to the ROM BIOS. If not, exit back to the foreground application so the clock software sees only 18 ticks per second.*

Listing 4: *At the end of the hardware clock interrupt, update a counter and see if it's the fourth tick. If it is, simply jump back to the ROM entry point in effect when you installed your own handler. By daisy chaining, the ROM software will never know you had control. If this isn't the fourth tick, reset the interrupt hardware and exit out of the interrupt routine. You won't call the ROM or any user clock software, but that's OK—they only expect to be called 18 times per second. To speed up the clock hardware, replace the default divisor with a smaller one.*

```
; part of the interrupt 08 handler...
chk_timer:
   inc    clock_div
   mov    al,clock_div
   cmp    al,4
   je     int_out2
; don't call the old one; it's not the fourth tick
   mov    al,EOI
   out    020h,al
int_out:
   .
   .
   .
; during the initialization...
; Speed up the clock by 4. The old divisor was 65535; we want 16384.
   cli
   mov    al,36h          ; mode 3, LSB then MSB
   out    Timer_ctrl,al
   jmp    short $+2       ; brief I/O delay
   jmp    short $+2       ; brief I/O delay
   mov    al,00h          ; LSB of 16384
   out    Timer_data,al
   jmp    short $+2       ; brief I/O delay
   jmp    short $+2
   mov    al,40h          ; MSB of 16384
   out    Timer_data,al
   sti
```

Now say that you intercept the hardware interrupt that normally goes to the BIOS. Maintain a counter for each interrupt that comes in, and on every fourth interrupt, hand control back to the ROM BIOS. On the other three, exit directly back to the foreground application. (See figure 3 and listing 4.) You'll have a 72-Hz clock, and the BIOS will have its 18.2-Hz clock and be none the wiser. The faster clock means a keystroke transfers in $\frac{1}{18}$ second instead of $\frac{1}{4}$ second.

Goodbye, Wimpy Keyboard

The last part is to tell the two computers which printer ports to use, but that's a simple matter of reading the DOS command line. It would also be straightforward to try each of the three possible ports, but this version doesn't bother. Once you get both programs assembled and cable the two machines with your LapLink cable, you're ready to run your notebook from your desktop's keyboard.

Some kinds of programs won't work: Programs that take over the keyboard interrupts and provide their own buffering won't find the data you're stuffing in the default buffer. Windows is a prime offender, as are XyWrite and many third-party keyboard-buffer enhancers. Also, programs that look for raw unprocessed key presses won't see them; your desktop doesn't pass those along.

Lastly, be careful of BASIC. BASIC doesn't know you've reprogrammed the clock, and it speeds it up four times, not knowing that you've already done that. When you exit back to DOS, BASIC puts the clock back to 18.2 Hz. Rerun KEYSLAVE.COM; it recognizes that it's already in memory and simply resets the clock rate. And note that while KEYSLAVE feeds data into the keyboard buffer, it makes no attempt to disable the notebook's keyboard. Both keyboards operate in tandem.

Now when I travel with a notebook, I can use the machine's standard keyboard on the road, and connect a cable and use my MultiMate Business Advantage keyboard when I get back to my desk.

KEYSLAVE could also come in handy in the BYTE Lab. We'll occasionally put a machine in our environmental chamber for low- or high-temperature testing. Prior to KEYSLAVE, there was no way to run the machine while it was under test. Now, if a vendor says its machine can run Lotus 1-2-3 at 120°, we can check it out. This could be the beginning of a new BYTE benchmark.... ■

Editor's note: *KEYSLAVE and KEYBRD are available in electronic format. See page 5 for details.*

Howard Eglowstein is a testing editor for the BYTE Lab. You can reach him on BIX as "heglowstein."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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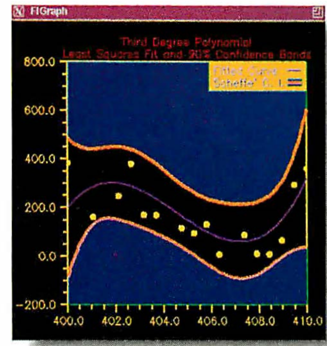
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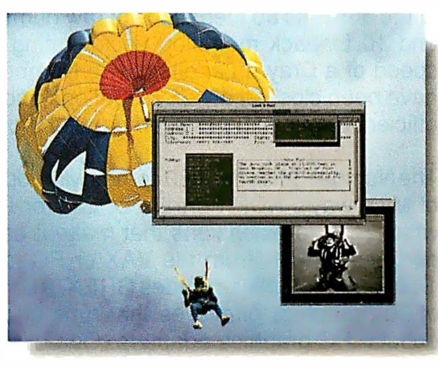
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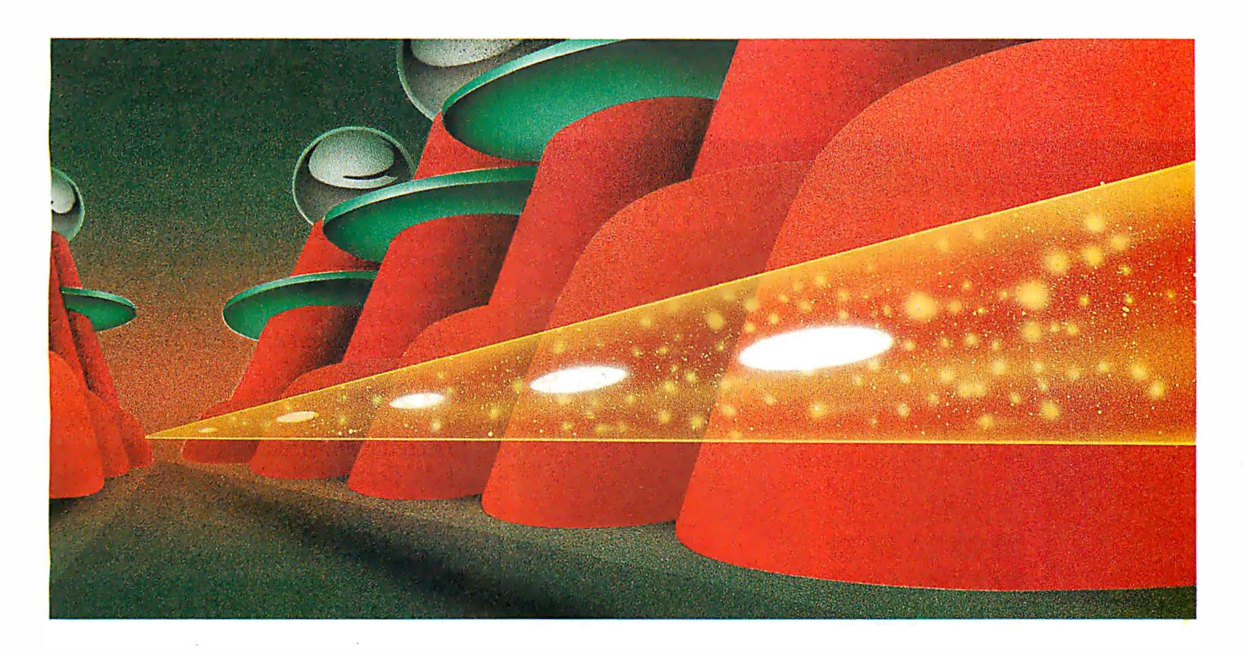


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PETER WAYNER

PROCESSOR PIPELINES



Making modern processors live up to their rated speed is no easy task. Although much of performance can be attributed simply to making chips smaller, a good bit comes from careful designs that keep data moving in a smooth and highly optimized path. At the center of modern chip architectures is the pipeline—literally, an assembly line for computation. Pipelines speed up calculations in much the same way that Henry Ford revolutionized car production.

Automotive engineers examine the list of tasks required to build a car and then split the list into jobs to be performed at *n* sequential stations. Each stage does its work and passes the result on to the next stage. If the engineers have done a good job dividing the work into *n* equal pieces, each car gets built in almost the same amount of time it would take without the assembly line—and *n* cars get worked on at the same time.

In the abstract, a computational pipeline works the same way. Computations are divided among *n* functional units. The first unit typically decodes an instruction into internal signals. When it finishes, it passes the instruction on to the next unit, which handles the next part of the computation—typically fetching data. (Meanwhile, the first unit starts decoding the next instruction.) Then the actual arithmetic is performed, and the results are stored in registers or memory.

The pipeline works faster because each small unit completes its task in about 1/*n* the amount of time as a large, single unit that does all *n* tasks. The result is that the processor effectively executes *n* instructions simultaneously. Each instruction still takes the same amount of time to complete, but the chip can go *n* times faster because a new instruction completes every *n* steps.

Henry Ford would have liked the Mips R4000, the IBM RISC System/6000, and the Intel 486

The idea sounds quite simple, but there are problems that make implementing a pipeline difficult. I'll compare the pipelines of some modern chips like the Mips R4000, the IBM RISC System/6000, and the Intel 486 to illuminate some of the details and design constraints facing computer architects today.

Superpipelined, Superscalar, and CISC/RISC Hybrid

A superpipelined processor like the Mips R4000 (see "The Mips R4000," December 1991 BYTE) attacks the throughput problem by pushing compartmentalization to the limit. The R4000's predecessor, the R3000, featured a five-stage pipeline. The R4000 goes further, subdividing instruction fetching and data cache access to create an eight-stage pipeline that advances at double the processor's clock speed. The stages of the R4000 chip's pipeline are Instruction Fetch First Half, Instruction Fetch Second Half, Register Fetch,

Instruction Execute, Data Cache Access First Half, Data Cache Access Second Half, Tag Check, and Write Back.

A superscalar processor, like IBM's RISC System/6000, implements multiple pipelines in parallel. The source of the RISC System/6000's speed is a unique and very well designed forked pipeline with separate paths for floating-point and integer instructions. If a program has a good mixture of both these instructions, the processor can keep both forks of the pipeline running at the same time. The RISC System/6000's pipelines share two initial stages before they fork: Instruction Fetch and Instruction Dispatch. What's special here is that the Instruction Dispatch unit also handles branching information. It decides which instructions to start feeding to the integer and floating-point pipelines.

The Intel 486 also sports a RISC-like pipeline—no mean feat for a complex instruction-set computer (CISC) processor. RISC chips like the R4000 and the RISC System/6000 feature simple instruction sets that make it relatively straightforward to balance a pipeline. The 8086 instruction set, by contrast, uses a variety of complex addressing modes that can't be decomposed.

The stages of the 486 pipeline are Instruction Fetch, Instruction Decode, Address Generation, Execution, and Write Back. The 486 is the only one of these three chips that has an address-generation step—needed because many of the 486's instructions intermix computation and memory access in complex ways. Note, however, that when the execution stage hits one of these CISC instructions, the pipeline stalls.

These chips take very different approaches to pipelines (e.g., in their problem-solving capabilities with regard to ordering the instructions). I'll review some major pipeline problems and look at how chip architects deal with them.

Data Dependencies

The rosy view that a pipeline will be able to execute *n* instructions with each clock cycle depends on having one new instruction to insert at the beginning of each pipeline at the start of each cycle. This is often a complicated proposition. What if the computer doesn't know what the instruction will be? This can occur if the code is self-modifying, if a branch instruction is already in the pipeline and the computer doesn't know which way the branch will go, or if an instruction expects to find the result of a previous instruction in registers. I'll start with the last of these hazards, often referred to as the data-dependency problem.

Imagine that you have one instruction (I1) that adds the value of register 1 and register 2 and places the result in register 3. The next instruction to follow (I2) uses register 3. The two instructions start moving down the pipeline one after the other. When I2 reaches for the value in register 3, there is a problem. The R4000, for example, gathers the values from the registers in the third stage of the pipeline but doesn't write back the results of the calculations until the eighth stage. When I2 gets to the third stage, I1 is in the fourth stage doing the addition. The pipeline must stall at this point until the value reaches the eighth stage. Four empty instructions go into the instruction stream, forcing I2 to wait at the register-load stage until I1 makes its way to the register-write stage. These empty instructions are often called *bubbles*.

Now consider what happens in the Intel 486, which has only five pipeline

stages. The writing back to registers happens right after the execution phase. This means that only one bubble needs to be inserted into the pipeline. Why, then, does the R4000 expose itself to such severe stalls, given that these data dependencies must be quite common? Mips has a solution: code reordering.

What if you had a smart compiler that would recognize when there was going to be a data dependency between two instructions? It might notice that there are four instructions that have nothing to do with register 3. It could move these instructions between I1 and I2, and when I2 got to the register-read step, the result of I1 would be waiting for it. Mips, in fact, has such a compiler that can reorder code so it flows optimally.

Data dependency affects the 486 less critically. The 486 pipeline is short, in part because it is much harder to reorder code for the 486. Chips belonging to the 486's family tree have only eight registers, and when you reorder code, you need extra registers to hold the values between the different instructions. When you spread out the instructions, you need to keep more values "live" at the same time. It's like juggling. The Mips chip can keep 31 balls in the air, but the Intel chip can handle only eight.

The order of instructions can make a big difference in throughput.

The important lesson is that the order of instructions can make a big difference in throughput. One approach to ordering places the burden on the programmer. For example, *The Intel i486 Programmer's Reference Manual* advocates arranging code to avoid data dependencies. Full-blown RISC chips, however, rely on compilers that automatically produce an optimal ordering. If the compiler doesn't do this, there are lots of pipeline bubbles, and throughput suffers.

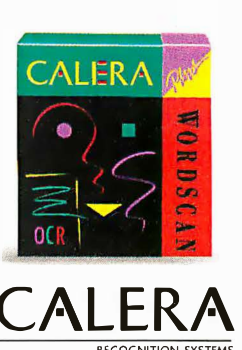
Branch Prediction

Data dependencies aren't the only way to stall a pipeline. Imagine that one instruction is a branch on the condition that a register's value is greater than zero. Which instruction should follow this branch instruction in the pipeline—the one that would follow if the branch were taken, or the one that would follow if the branch were not taken?

Engineers have analyzed traces of thousands of programs running through processors. They've found that when branches point backward toward the beginning of a program, they are taken about 90 percent of the time. This pattern corresponds to loops that often execute many times. When branches point forward, however, they are taken only 50 percent of the time. For this reason, the 486 and the R4000 will make a guess and follow the path most taken. If the guess turns out to be wrong, the pipeline must be flushed clean and started again with the correct instruction. The 486 loses

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three cycles when this happens, because there are three stages between the execution unit that decides the branch and the beginning of the pipeline. The R4000 only loses two, because it does not have the extra address-generation step. This is one place where the clean RISC instruction set pays off.

One standard solution to this problem is a delayed branch. In this case, a pipeline is not cleared, and the instructions that are in it are allowed to finish. To a programmer, this means that a branch may come into effect one or two instructions *after* it is executed. This can be quite useful if it is possible to move an instruction with no data dependencies later in the instruction stream. For instance, consider the case where one instruction (I1) is R1 + R2 −> R3 and the next instruction (I2) is IF R4>0 THEN Branch. It's possible for I2 to go down the pipeline before I1 does. Then, if the branch is taken, I1 can execute, and the program is not required to insert bubbles. The compiler must be aware of this problem and be able to shuffle the code around without destroying dependencies.

The RISC System/6000's approach to the branch dilemma differs from that of the 486 and the R4000. Its instruction set has an additional compare instruction that will set a 1-bit condition-code register based on the values in some data register. The branch instruction simply tests the value of this condition register.

Just splitting the branch instruction in two doesn't solve the problem of delays when an unexpected branch is taken. The compiler must still position this condition-code instruction at least three instructions before the branch to ensure no lost time. In this respect, it's just like the Mips delayed branch—the register values being tested must still be ready three instructions before the branch.

The difference is that the RISC System/6000's instruction dispatch stage, which comes second in the pipeline, decides branches. The R4000's branch instruction is computed by the execution stage. The branch instruction must travel the length of the pipeline, and if the branch isn't taken, it ends up as a bubble. The RISC System/6000 doesn't prejudge a branch. It fetches and starts decoding the computational instructions from both sides of the branch. When the condition code is set and read by the second stage, it then sends the correct instructions down the pipeline to be executed. There is no branch instruction traveling like a bubble down the pipe.

Of course, this won't work every time. There will be many situations in which the IBM compiler will not be able to move the condition test three instructions before the branch. The chip designers, though, analyzed the instruction streams of many programs and decided that the strategy would pay off on average.

The Resistance of Memory

Although silicon memory has gotten relatively inexpensive, it has not become correspondingly fast. Several very fast cycles of modern CPUs will be wasted before the memory answers with the right value. For this reason, RISC instruction sets are designed to decouple the loading and storing of information from the computation on that information. That way, a compiler can schedule the load of a value several instructions before the computation takes place with the value. The RISC System/6000 and the Mips R4000 both take this approach. It's one reason that RISC chips have many registers: They need places to store

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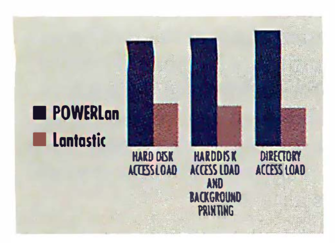
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LAN Times, June 17, 1991



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May 28, 1991
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values as loads and stores occur.

In the R4000, execution comes third in the pipeline, and memory access comes afterward. This is a great compromise, because it means the chip has only a two-cycle latency when a branch is not taken. The memory-access stages cannot cause the pipeline to be flushed, so it doesn't matter if they come later in the pipeline. Mips is betting that the compiler will be able to move the load and store instructions far enough apart to ensure that there are no data dependencies.

The 486's CISC instruction set includes instructions that load, compute, and store in a single operation. The loads and stores are, therefore, bound to the execution stage. Intel's engineers would probably like to have made the 486's execution stage come third instead of fourth so that a bad branch would result in a shorter pause, but they needed the address-generation step. In the end, the engineers did a careful analysis and decided that the benefit of the address-generation step outweighed the cost of lost cycles at branches.

What if the Pipeline Stalls?

At this point, you should realize that there is plenty of code being reorganized to keep the R4000 and RISC System/6000 pipelines from stalling. The RISC philosophy has always assumed that compilers will be able to make the right decisions and reorganize everything. In the worst case, this can be a pretty difficult problem. A compiler might need to consider an exponentially growing number of possible solutions before coming up with an answer. In most cases, however, a compiler is able to find a good solution and make it work.

Even if optimization fails to avert a stall, however, there's still merit in the pipelined approach. Consider this short section of code:

```
Load R1,Address #1
Load R2,Address #2
R1 + R2 -> R3
Store R3, Address #3
```

The third operation—an addition—cannot finish until the two loads do. The addition operation stalls at the register-access stage until this happens. However, when the information from the loads becomes available in the registers, the arithmetic instruction has already been decoded. A nonpipelined machine would not have this head start.

Rearranging the Code

Although RISC chip users have always known they would need smart compilers, many PC users are not used to the notion of pipeline optimization. The order and arrangement of instructions can affect the running speed of the 486 in a substantially different way than it affected earlier chips. Although the 486 will still run 8088 programs, some combinations of instructions exploit the pipeline much better than others do.

One example is indexed addressing. The 486 works faster if you use simple instructions that do not require it to add an index register to a base register to determine an operand's address. Here is an example from *The Intel i486 Programmer's Reference Manual*. The instruction

MOV EAX, [ESI]

uses ESI as a base register and loads from the location it points to. The instruction

MOV EAX, [ESI*]

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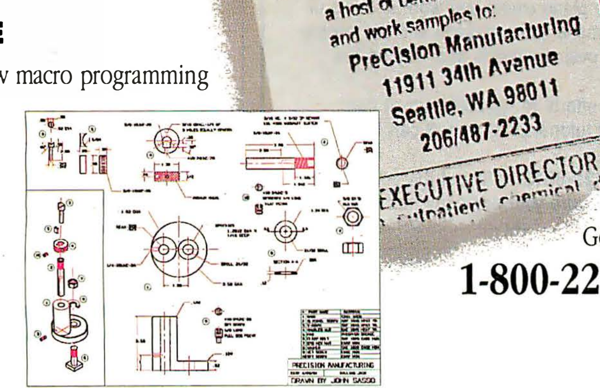
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AUTODESK

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Execution and write-back are separate stages.

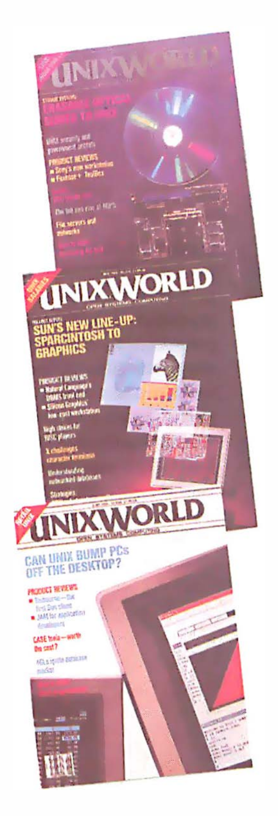
uses ESI as an index that is relative to another base register. In the first case, the address-generation step in the pipeline will be able to find the right address in one clock cycle, and the pipeline won't stall. In the second case, extra arithmetic needs to be done in the execution stage, during which the pipeline will stall.

A programmer should also bear in mind that execution and write-back are separate stages. The pipeline will stall if one instruction computes a value and the next instruction needs that value for an address computation. Here's another example from the Intel manual:

```
ADD ESI,EAX
MOV EAX, [ESI]
```

The first instruction puts the sum of the EAX and ESI registers into ESI. The next instruction needs that result. The problem is that the value from the ADD instruction isn't written back until the last stage in the pipeline, so the MOV instruction must stall one cycle until the result becomes available. Assembly language programmers or smart compilers can actually schedule a third instruction between these two to get more work done. The ADD instruction won't take any longer to execute, assuming the intervening instruction introduces no new pipeline conflicts. As it turns out, although Intel's own 386/486 Code Builder has a "486 switch," that compiler doesn't yet attempt such reorderings. Watcom has tried some experimental pipeline optimizations with its 386/486 C compiler and reports that although speedups are possible, it is tricky to achieve gains without spilling scarce registers. Still, given the intensely competitive nature of the PC compiler market, you can be sure you'll be seeing advertisements touting 486 pipeline optimizations before too long. ■

Peter Wayner is a BYTE consulting editor and is working toward a Ph.D. in computer science at Cornell University. You can reach him on BIX as "pwayner."



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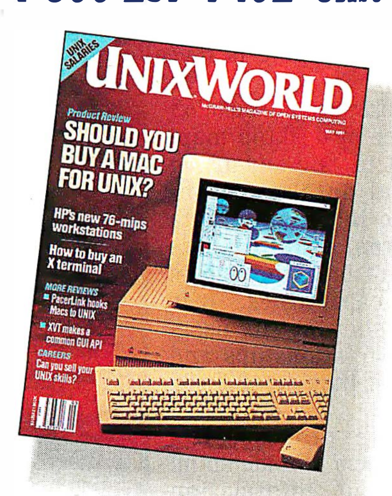
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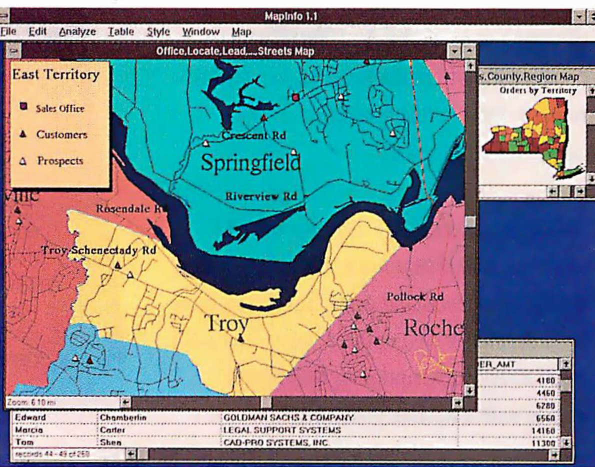
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BARRY NANCE

MEMORY MAPPING, EDIT II, AND AN ALARM CLOCK

Using memory control blocks to track memory use, a Mac editor, and a Unix alarm clock

This one has been done before. Quarterdeck's Manifest, Norton's SI, and Kim Kohkonen's Mapmem all show what's in DOS memory. Programmers have found dozens of ways to tell you why you don't have a full 640 KB in which to run your applications. But the interesting part of these utilities is not so much the results (OS/2 2.0 solves that problem by giving me multiple DOS sessions), but the way in which DOS sets up and manages its memory control blocks (MCBs).

This month, I'll examine how these programs work and offer a program that lets you find out how big the resident portion of DOS is and what TSR programs you have loaded. The C source code for MAPRAM is only about 8 KB, yet it tells you how to gauge DOS and TSR RAM use. MAPRAM detects the presence of expanded memory (the MAPRAM source code shows one of the two techniques you can use to find out if an expanded memory manager is present) and shows the total amount of expanded memory and the amount currently free. If you follow MAPRAM with any argument on the command line, it lists the device drivers you've loaded as well. You can compile MAPRAM.C with either Turbo C or Microsoft C, or just run MAPRAM.EXE.

Programming Techniques

Here's the lowdown. MAPRAM uses DOS function call 52 hexadecimal to locate the start of both the device-driver chain and the first MCB. After the call, the ES:BX register pair points to a special data table within DOS itself, sometimes called the DOS INVAR area. At 22 hexadecimal bytes into the table, you'll find the offset (near pointer) of the first device driver; each device-driver header thereafter points to the next device driver in the chain. MAPRAM.C contains a definition for the device-driver header structure, as well as for MCBs and for the Program Segment Prefix (PSP).

Two hexadecimal bytes before the special data area is a near pointer to the segment address of the first MCB. Each MCB consists of a flag byte ("M" for all MCBs except the last one, which is "Z"), 2 bytes that indicate the owner of the MCB (the PSP segment address for the process that is using the MCB), and 2 bytes that express the size, in 16-byte paragraphs, of the MCB's memory area.

Once you have a far-pointer address to the first MCB, you step through the chain of MCBs by simply adding the size field plus 1 to the current MCB's segment address.

MAPRAM.C also shows how to discover the name of the program that owns the MCB. Beginning with version 3.0 of DOS, the fully qualified name of the program's executable file follows the environment area for each program.

Many programs show what's in memory. MAPRAM.C shows how to get inside DOS and its MCBs, so you can use the information in your applications. ■

UNIX/Ben Smith

A Calendar Alternative

If you're a Unix user who doesn't use the X Window System and thus can't take advantage of the `xcalendar` program mentioned in the November 1991 Software Corner, don't despair. There is an excellent text-based equivalent, `remind`, which was written by David Skoll, an electrical engineer working at Carleton University in Ottawa, Ontario, Canada. Because `remind` was originally written for DOS, the current version (2.3) can be compiled for either operating system.

The `remind` calendar and reminder utility uses sophisticated parsing and date/time algorithms to generate messages (and spawn processes) that are tied to specific dates or very complex date and time specifications that can include offsets, repetitions, and relations. For example, you can generate a reminder for every three days prior to a meeting on the last Friday of every month by specifying the key `Friday 31 +3`. You can use `remind` as an alarm clock or even as an alternative to the Unix `at` and `crontab` utilities.

MAC/Tom Thompson

A Slick but Cheap Mac Text Editor

One of the problems that plagues the new Mac user is writing something. There's no built-in utility, like EDIT.EXE on PCs, where you can at least cobble together a simple text file. Mac word processors cost plenty: $100 and up. (Remember when MacWrite 1.0 was bundled with the Mac?) What's a person who wants to create simple text files to do?

The answer is Kenneth Seah's Edit II, which is modeled after Consulair's old Edit text editor. However, Edit II sports many improvements over its predecessor: It's compatible with the latest Mac OS, and it uses the keyboard cursor keys for pointer positioning. Also, the standard command-key sequences let you save and print files. But wait, there's more. Edit II can deal with text files that contain only linefeeds (you get such files when you download text from Unix systems like BIX), the text search has a built-in `grep` capability, and you can search for a text sequence on multiple files. All this for a modest $25. Captain Video says check it out.

Editor's note: *Software Corner highlights freeware and shareware programs. The programs are available in a variety of formats. See "Program Listings" on page 5 for details. We solicit your contributions for this column. We'll pay $50 for any program we use. Write to: Software Corner, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

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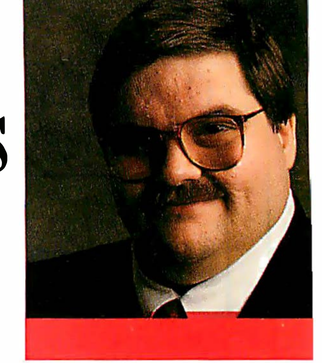
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DON CRABB

Programming Under System 7.0

What tools do you need to do crackerjack programming on a System 7.0 Mac? The answer to that question depends almost entirely on the type of programming that you expect to do. At different times and for different purposes, I have been happy with HyperCard, ParcPlace Systems' Smalltalk, Manx Software Systems' Aztec C, Apple's MPW and all its languages, Symantec's Think Pascal, TGS Systems' Prograph, and a few others.

I have noticed a phenomenon taking place on Windows, though, that I wish we'd see on the Mac: the introduction of competitors to the standard development kit. In the case of Windows, the standard development kit is Microsoft's Software Development Kit. It functions like Apple's MPW and MacApp, although the SDK doesn't come with any compilers. Other vendors, and even Microsoft itself, are now producing competing development products for Windows. Microsoft's own Visual Basic and Within Technologies' Realizer are good examples. With these systems, I can sit down to do Windows software development without having to strap a language onto the SDK and fool with each of those tools.

A Real Need

It's certainly true that MPW and MacApp are light-years ahead of the SDK, so third parties who might provide systems like Visual Basic or Realizer for the Mac might not see a market there. I think they are wrong: The Mac has a large-enough installed base, supporting every stripe of developer (from in-house types, to commercial developers, to weekend hackers), to make competition for MPW and MacApp a market to explore.

Still, the competition hasn't been forthcoming. Instead, most third-party development system vendors tout their compatibility with MPW tools and their source and object compatibility with MPW compilers. With System 7.0 causing problems in non-Apple development environments (either they aren't 32-bit clean, or they can't use virtual memory—a significant limitation for any development system), MPW and MacApp look better than ever. Unfortunately, all of this has stifled development competition in a way that's probably not healthy for the long-term success of the Mac.

This is an issue of concern to the computer science labs at the University of Chicago. While I have no qualms with MPW's completeness and its general robustness, it's a bit much for our introductory programming students. It's also a bit much for some of our lab Macs, which are still Mac Pluses (albeit with 4 MB of RAM, hard drives, and AppleShare server connections). In other development environments, academia especially, most developers don't have Quadra 900s sitting next to their desks.

Some of your friendly old language systems don't yet work with Apple's latest System



Although we use MPW and MacApp for our upper-level classes, we need good development tools for our lower-level classes, preferably ones that are compatible with MPW but won't break our bank.

Think Pascal

The one program that has fit the bill better than any other over the last two years is Symantec's Think Pascal 3.0. Unfortunately, version 3.0 won't run under System 7.0, and the patched version (3.0.2) that's supposed to work when you turn off virtual memory and 32-bit addressing happens to be quite buggy. Fortunately, Symantec was on the ball and revised the product to include full System 7.0 support (32-bit and virtual memory). Think Pascal 4.0 will fill the needs of our lower-level programming classes.

Think Pascal 4.0 works well under System 7.0, although the installation is annoying (it comes on four floppy disks and includes a set of seven Compact Pro self-extraction archives). It includes a hellacious compiler that can crank about 60,000 lines of code per minute on a standard Mac IIci. That's some serious code compilation for a desktop computer.

My favorite part of Think Pascal 4.0 is its class browser. Yes, you heard that right. It has an object-oriented programming (OOP) implementation of Pascal, and the class browser helps tie it all together. It works much like a Smalltalk class browser. With the browser, you can edit and examine every class and method and all the bits of allied code you might have for a particular project. It's a handy implementation and one that other language vendors ought to adopt.

Think Pascal 4.0 also supports the Standard Apple Numeric Environment math

Mac buyers no longer have to pay a premium for hard drives.

package, the full Think class libraries (including those shipped with Think C), MPW object code, and in-line machine code directives that are good for writing device drivers and getting them up to speed. It can generate code for the 68000, 68020, and 68030, and the 68881/2 math coprocessors, although there is as yet no support for the 68040. That will be a problem for Quadra buyers or others who plan to buy the new 68040 accelerators from Radius and DayStar Digital.

Prograph

If you'd like to try something less traditional than a Pascal implementation, another of my favorites, Prograph 2.5 from TGS Systems, just got better. Prograph is a personal programming system for the Mac. It's based on OOP, a GUI, and data flow diagraming techniques (remember those babies from your first structured programming class?). Prograph 2.5 includes an improved compiler and full System 7.0 support, just like Think Pascal 4.0.

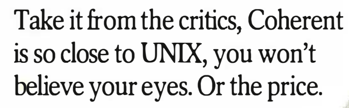
You see Prograph's data flow diagrams when you edit or invoke a new method. Instead of writing a method script, as you would do in Smalltalk-80 or C++, you build Prograph methods using data flow diagram components that you select and connect in the programming sequence you need. In other words, you construct your method's algorithm using building blocks, much like the tile-connection method found in Odesta's Double Helix. You build every Prograph 2.5 application using objects, methods, and data flow diagrams.

Prograph includes single inheritance, which lets instances of the same class inherit properties or behaviors from all those classes that precede it in your overall object-classification scheme. Inheritance provides great savings in repetitive coding, simplifies overall application design, speeds up compilation, and lets you concentrate on creating your application instead of the development environment.

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traditional programming, check out Prograph. It's a superior environment in which to learn how to create Mac applications, and you don't have to learn all the overhead of the traditional systems.

Despite the usefulness and success of systems like Think Pascal 4.0 and Prograph 2.5, I'd still like to see some full-blown competition to Apple's MPW. I'd also like to see Apple give MPW a complete overhaul (I hope that it takes a close look at NextStep when it does), so Mac developers would have the same kinds of growing choices as Windows programmers are now finding on their PCs.

Tip of the Month

If you follow such things, you know that hard drive prices from Mac vendors have gotten so low they've become commodity items, just like PC hard drives. That's great news for Mac buyers: You no longer have to pay a premium for hard drives. But as prices have dropped, so has quality. And the paper-thin profit margins that such price drops engender are killing some drive manufacturers. Some companies, like Jasmine Technologies, have gone bankrupt twice. That's pretty scary.

Where do you turn for your Mac hard drives, then? Fortunately, I have found several vendors whose products are both reliable and fairly priced. GCC Technologies and Mirror Technologies are two such companies. I've written about GCC's UltraDrive S series before; Mirror Technologies underwent an internal reorganization in the last year and is better for it.

I've been using Mirror hard drives for about six months now. They are solid, well constructed, and still low priced. And they have all the basic features you need. Unlike some cheaper units that preterminate their drives internally, the Mirror drives are unterminated and come with external SCSI terminators. You can easily set the SCSI ID numbers from an external switch.

I just ordered a few dozen of the mirror drives for my labs. The external units come in sizes from 40 MB to 1 gigabyte, and each has a rugged plastic case that's about the same size as an Apple HD80SC external drive.

Mirror also sells removable-medium drives (SyQuest Technology and Sony magneto-optical cartridges), a digital audiotape drive, internal drives, small portable drives (about the size of the Integrated Data Storage Systems' Wip drives I use that work well), and RAM SIMMs. I hope to check out the removable-medium drives as part of a column I'm working on for later this year.

For now, I'd put Mirror Technologies on your short evaluation list when you're thinking about buying hard drives. ■

Don Crabb is the director of laboratories and a senior lecturer for the computer science department at the University of Chicago. Don is also a contributing editor for BYTE. He can be reached on BIX as "decrabb."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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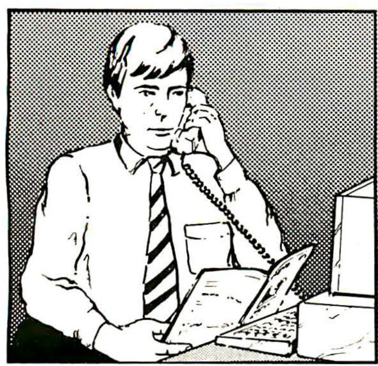
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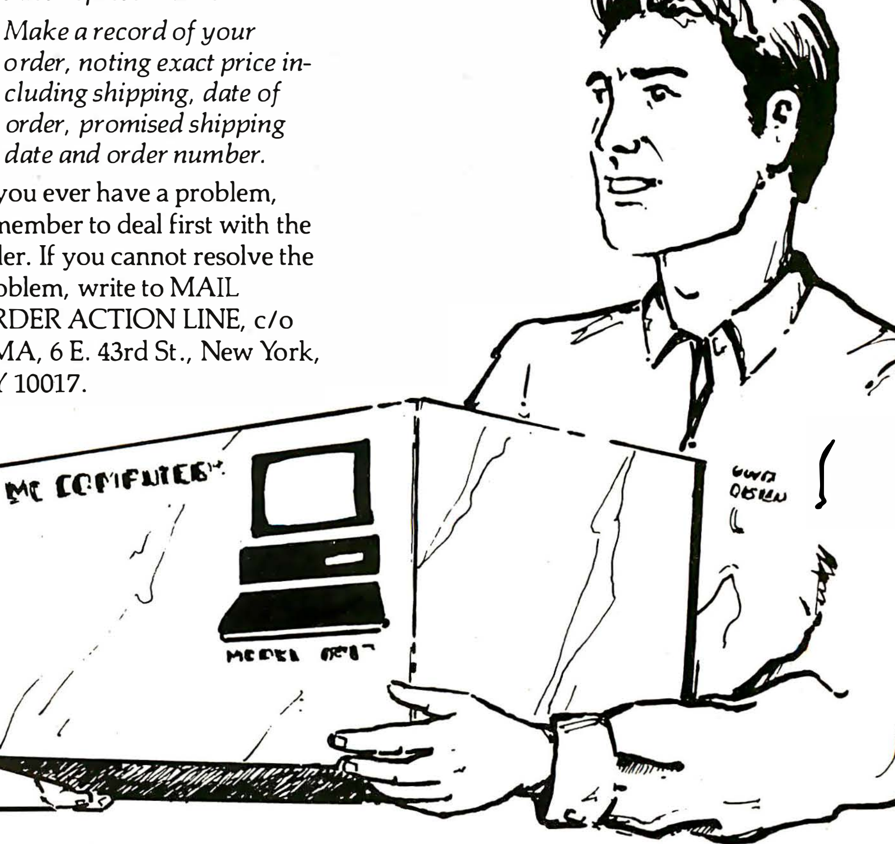
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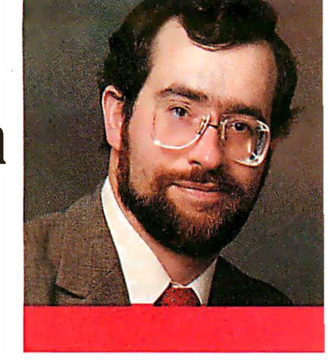
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DAVID FIEDLER

ACES WILD

It's another new year. Has Unix taken over the world yet? No, but it would be hard to deny that Unix users are in the mainstream. In fact, if you take industry rumors, initiatives, coalitions, and consortia as a bellwether of importance, Unix has figured in most of the important computer announcements of the past year.

MIS executives must be tearing their hair out when asked to determine their hardware and software strategy for the future. Mainframe shops are running on microcomputer networks, notebook Unix systems aren't big news anymore, PC companies are building workstations, and workstation companies are selling their operating-system environments to PC users.

The Real Battleground

The Advanced Computing Environment (ACE) initiative announcement last spring confused many people, because it initially announced support for three main standards that themselves raised questions. Some observers focused on the CPU angle, because that's considered the most important thing by many buyers, but it's only one part of the story.

To summarize, ACE's chief players are Microsoft, Mips Computer Systems, DEC, Compaq Computer, and The Santa Cruz Operation (SCO). The idea behind the ACE consortium is to develop an open standard for RISC computers based on CPU technology from Mips. You might think of ACE as Sun Microsystems' SPARC developed by committee, and in many ways, this is the computer industry's answer to SPARC.

Although SPARC is an open-architecture CPU and is available from a number of sources other than Sun, many people see it as Sun's proprietary product. This impression was not helped by Sun's attempt last year to stop its resellers from selling SPARC compatibles.

Thus, heavy hitters DEC and Compaq (plus many ACE members, including Sony, NEC, Acer America, and Silicon Graphics) are backing Mips and its products instead of SPARC. Sun's share of the market was more than three times as large as Mips' in 1990, but the Mips line of CPUs is still one of the largest in terms of total workstation shipments. ACE is therefore betting on a company with proven performance, and one that's not afraid to loosen its technology grip: Five other manufacturers will be making Mips R4000 chips.

DEC has been in Mips' corner for years and has based its entire RISC line of DECstations around Mips technology. Compaq, by throwing its support to Mips, is openly challenging Sun.

The coalition complexities of the ACE standard and Sun's new Solaris 2.0



ACE is tacitly backing another company as well. By developing its standard around the IBM PC's ISA, ACE is acknowledging the hold that Intel CPUs have on the market.

Hidden Agendas

When ACE was introduced, the two software-related parts of the story were that ACE would have two operating-system platforms: Open Desktop from SCO and OS/2 3.0 from Microsoft. The twin ideas were that OS/2 would run on ACE RISC-based machines (as well as ISA PCs) and that Open Desktop would be ported to ACE RISC-based workstations (as well as ISA PC workstations).

Standards have changed a bit since then. DEC is doing most of the Open Desktop operating-system development and porting, and Microsoft has completely dropped OS/2 in favor of Windows New Technology (NT). And AT&T's Unix Software Laboratories has gotten into the act by coming up with a binary compatibility standard for Unix System V release 4 (SVR4) that is almost, but not quite, completely incompatible with the ACE standard.

These statements require a bit more background. SCO has traditionally played more of a director's role than that of a Unix porting house. It's good at putting pieces together, which is one reason why Open Desktop—based on software from AT&T, Locus Computing, IXI, Ingres, Open Software Foundation, and others—has been so successful. This is not to deny SCO's own internal Unix kernel expertise. In this case, however, it seems as though SCO's role in the new ACE Open Desktop is to make sure that all the pieces come together correctly, and DEC's role is to do the actual kernel work.

As far as Microsoft goes, it's true that OS/2 3.0 will no longer be produced (in deference to the well-publicized Microsoft/IBM rift), but it's also possible

that Windows NT is basically OS/2 3.0 under a new and snazzier name.

Meanwhile, SVR4 for the Mips CPU line uses the "big-endian" byte order, so applications for it will be incompatible with the "little-endian" ACE standard—even though ACE and SVR4 will themselves run just fine on any R4000-based computer.

Is ACE the Place for You?

When all is said and done, several implicit promises shake out of the hype. One is that an ACE workstation could be made simply by plugging an ACE CPU board into an AT clone and rebooting with the ACE operating system. Another promise is that an ACE binary application will run on any ACE-compatible computer unchanged (now, where have we heard this before?). I'd like to see both these things happen before I bet my data-processing budget on ACE.

There are also a few problems. The most-advanced Mips CPU at the time of the announcement was the R3000, which didn't comply with the specifications designed by ACE. The 64-bit R4000 chip, announced last fall, does meet the ACE

Applications for SVR4 for the Mips CPU will be incompatible with the ACE standard.

specifications, but delays caused many systems designers to work with the R3000 instead.

If Windows NT dominates the market for high-end PC operating systems as Microsoft hopes it will, it could put the brakes on the acceptance of Unix, just as people are starting to get used to the idea. But to do this, Microsoft will have to duplicate the success of Windows 3.0 and MS-DOS 5.0, which were mature products with a large amount of market acceptance when they were released. Windows NT breaks new technical ground and represents an entirely new direction for Microsoft's marketing skills.

By supporting Windows NT and Open Desktop Unix on the PC and RISC platforms, ACE is hedging its bets. When real products are introduced, Open Desktop will have the advantage of several revisions and years of marketing. It will be an interesting battle, particularly because Microsoft can't lose: It owns a piece of SCO.

What About Sun?

The Sun empire struck back by announcing its Solaris 2.0 product for SPARC and Intel 386/486 architectures. In one bold move, Sun has postulated a world where it might use its name and quality recognition to become the leader in PC Unix software.

Solaris includes not only SunOS 5.0 (based on SVR4), but also OpenWindows (a development system), Open Look (the GUI), DeskSet (some basic applications), and the OPENetwork utility services. It's almost a Sun version of Open Desktop in a box at a competitive price (although, like



Solaris for the SPARC, Solaris for the 386/486 will probably be delivered on CD-ROM, which also saves a heck of a lot of money on documentation).

If this weren't bad enough news for SCO, it's likely (as this column goes to press) that Sun will buy Interactive Systems, SCO's archrival. Sun will thereby get a great deal of PC Unix and networking expertise in one package.

Sun is also hedging its bets, because the creation of its SunSoft subsidiary and an Intel port of SunOS mean that it can at least pay some bills by selling software, even if SPARC sales drop. After all, Sun has been a leader in developing applications software, so what would happen if it was suddenly in a position to sell applications directly to millions of power PC users?

The bottom line for users will be better, faster, and less expensive computers capable of running the new graphical Unix systems. That's good news. The final chapter on ACE will be written when the consortium delivers its hardware and software, and it's a bit early to commit to that platform. If nothing else, ACE and Solaris prove that there's some life in ISA yet.

Some People Really Know Zip

There are several different, and incompatible, standards for compressing and archiving files. These include Pack, Compress, Arc, Zoo, and Zip. Some programs (e.g., the public domain Arc utility I've been using for Unix) are capable of dealing with DOS .ARC files. But in general, folks who use both Unix and DOS keep their files separate.

For those of us who use DOS in conjunction with Unix (e.g., on VP/ix or Open Desktop), it's convenient to use one tool that does the job well. I've been working with Uni-Zip from Precise Electronics for a few months, and it gives 386-based Unix users all the capabilities of PKZip from PKWare, including complete file compatibility.

Uni-Zip keeps PKZip's syntax and file structure, and it gives you a 32-bit cyclic redundancy check missing in many Unix archive and compression programs. If you're not familiar with PKZip, it (and Uni-Zip) lets you work with directory trees, attach comments to files, and update and "freshen" specific files without disturbing the archive as a whole.

My tests showed that Uni-Zip produced a tighter compression than either Compress or Arc, although it was slower than Compress. What I like about Uni-Zip, and archive programs in general over compression programs, is the ability to store lots of files into one but being able to pull them out separately later. ■

David Fiedler has been a consultant and writer on Unix topics for over a decade and has started several Unix publications. His company, InfoPro Systems, produces corporate image and marketing videos for high-tech firms. You can reach him on BIX as "fiedler."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

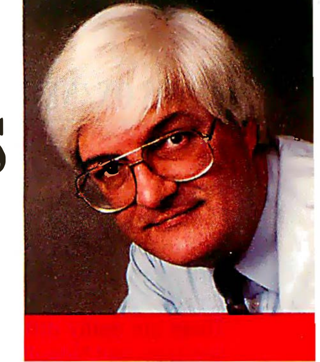
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BARRY NANCE

Coming Soon: Faster LANs

Networking is so complex and pervasive that it just doesn't make sense to compile a list of significant events that happened in 1991, or to predict the major events that might occur this year. My memory of 1991 is probably different from yours, and my list of 1992 predictions would likely embarrass me at the end of this year.

Instead, here's an in-depth look at two network-related technical innovations currently on drawing boards and in engineering labs that you'll see this year. The first, Novell's *packet-burst* technology, is significant if you're interested in LAN performance. This includes most of us. The second, IBM's 100-Mbps Token Ring, is also performance related, but it will have a significant effect on PC networking in general—especially if it's priced right.

Packet Burst

Novell already had the packet-burst enhancement working fairly well in its labs at press time. In fact, by the time you read this, you may already have seen an announcement of what Novell calls packet burst for NetWare.

Packet burst is a funny name for a technique that was added to the Kermit and XMODEM file transfer protocols a long time ago, and it forms the basis for the ZMODEM protocol. Packet burst involves sending file material to or from the file server in a long stream of packets, without requiring the workstation to issue a request for each small section of a file.

Before packet burst, an application (or COMMAND.COM, if the workstation is in the process of loading the executable file) might issue a request to DOS to read a large part of a file that resides on the file server. As an example, I'll use a request for a 64-KB chunk.

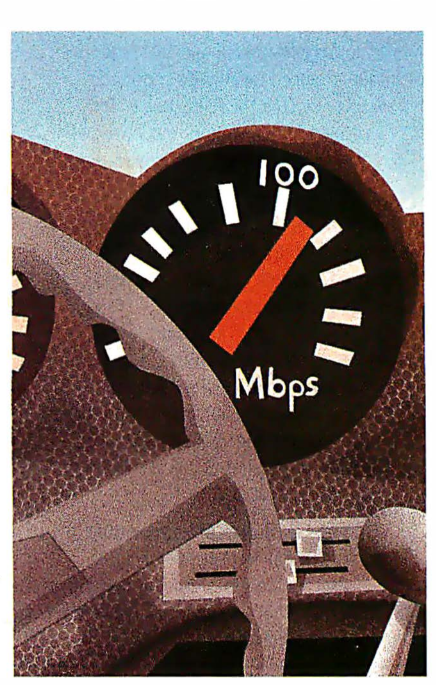
The NetWare shell, NETx.COM, intercepts the file-read operation; DOS never sees it. Assuming that your network uses 512-byte packets (common on NetWare LANs), NETx and the server exchange 128 pairs of message packets to accomplish the 64-KB read.

The workstation requests the first 512-byte packet; the server sends back a response containing the first 512 bytes of the file. At the workstation, NETx puts this first response at the start of the application I/O buffer and then makes another request of the file server for the next part of the file.

When it receives the response, NETx appends this next 512-byte part of the file to the previous material in the application I/O buffer and requests the next portion. This dialogue goes on until NETx on the workstation and the file server satisfy the entire 64-KB file-read operation.

If your LAN uses packets larger than 512 bytes, the network generates fewer than 128 pairs of request/response packets. But it's still quite a lengthy process—especially if one workstation's requests/responses are interleaved on the network with similar traffic to and from several other workstations. The turnaround time for a workstation to issue the next request and get that request onto the LAN is substantial.

Two upcoming products from IBM and Novell could have a big impact in 1992



With packet burst, NETx makes a request for the entire 64-KB file as one message packet. The file server sends back a stream, or burst, of packets containing sections of the file material. NETx copies the message contents into the application I/O buffer, one after the other, as they're received. NETx and the server then account for what's been transmitted, and NETx can restart the data stream at any point to handle missed packets.

When packet burst is available, you'll merely have to install and load a new NetWare loadable module on your NetWare 3.11 file server and begin using a new version of NETx.COM. It was still unclear at press time if Novell will charge extra for packet burst.

Another term for packet burst is *sliding windows*. This term suggests several successive windows of activity, where each window consists of a response packet. Instead of acknowledging each packet as it arrives, the workstation acknowledges the entire group of packets with one "thanks, I got all the packets" message. Packet burst gets the same job done with fewer packets flying around on the network.

There's one problem with packet burst, though, and it's the reason why you have not seen this technology before now. Say I have a slow, archaic IBM XT, and you have a powerful, fast PS/2 Model 95. We use the same device drivers, the same IPX.COM, and the same NETx.COM. Your Model 95 initiates a read request for a large file on the file server. My XT reads a 2-KB record from a database file located on the same server. Your request

ILLUSTRATION: ROGER BOEHM © 1992

gets to the file server first. Mine arrives a millisecond later. How should the file server behave to keep us both happy? There are many different answers to this question, and Novell's software engineers are trying to pick an answer that is fair and that imposes the least workload on the file server and the workstation.

It will be interesting to see what the production version of packet burst looks like and how much of a performance improvement you will see from it. I'm vitally interested in LAN performance; I can't wait to try out Novell's packet burst scheme.

There is a business need for 100-Mbps Token Ring LANs, and IBM is getting ready to respond.

Token Ring Turns 100

IBM invests more money in R&D than many companies earn in total revenue. However, IBM announces new products only after it talks to its customers and discovers a "business need" (and, I expect, after thorough testing). There's a business need for 100-Mbps Token Ring LANs, and IBM is getting ready to respond.

In 1985, IBM and Texas Instruments codeveloped and released the 4-Mbps Token Ring. IBM could have endorsed Ethernet, but the IBM/TI network designers determined that Token Ring had certain reliability and speed advantages over Ethernet, especially on large LANs. Ethernet advocates have disputed this design decision for years, yet Token Ring remains the IBM standard for connecting PCs, AS/400s, RISC System/6000s, and mainframes.

IBM recognizes the need to connect its hardware with non-IBM, Ethernet-based LANs. Thus, IBM supports its own flavor of Ethernet, called EtherAND. But it will be a long time before you can use Ethernet to connect PCs, AS/400s, RISC System/6000s, and mainframes.

A few years ago, IBM released its 16-Mbps Token Ring product, with the optional Early Token Release feature. ETR reduces latency time by releasing the token before the previous data frame has finished circulating through the LAN (see the text box "ETR Explained" on page 336 for details). ETR becomes a significant factor when packet sizes average 50 to 100 bytes and when network traffic levels are less than 80 percent (most are).

IBM will soon release a 100-Mbps Token Ring product with an enhanced ETR feature. The company will emphasize the use of 100-Mbps Token Ring as a connective backbone between mainframes and PC LANs, but many buyers will use it as their primary LAN medium for applications where performance is critical. IBM will announce faster-processing Token Ring adapter cards, with more on-board RAM and perhaps even an on-board CPU chip, at the same time that it announces

ETR Explained

Early Token Release is easily misunderstood; Token Ring LANs are in themselves a fairly complex subject. On a momentarily idle Token Ring LAN, workstations circulate a token. The LAN becomes busy (i.e., carries information) when a workstation gets a token and turns it into a data frame, targeted almost certainly at the file server (or targeted back at a file-needy workstation if originated by a server that is answering a file I/O request). The data frame, after receipt by its target node, continues its circulation of the LAN until it reaches its source node. The source node turns the data frame back into a token that circulates until a downstream node needs it. So far, so good. These are just standard Token Ring concepts.

A workstation needs to send only a few bytes to tell the file server it needs some part of a file. If the signal has to go into and out of many workstations to circulate the ring, and if the data frame is small, latency occurs. This is the unproductive delay that occurs while the source node waits to get its data frame returned to it by its upstream neighbor.

After releasing the data frame, the source node appends idle characters onto the LAN until the data frame has circulated through the entire LAN and arrives back at the source node. The typical latency of a 4-Mbps Token Ring is about 50 to 100 idle characters. On a 16-Mbps ring, latency can reach 400 or more bytes worth of LAN time.

With ETR, the originating workstation transmits a new token immediately after sending its data frame. Downstream nodes pass along the data frame and then receive an opportunity to transmit data themselves—the new token. If you had a Token Ring microscope, you'd see tokens and other data frames chasing the data frame, instead of a long trail of idle characters. And you'd know that your LAN is using ETR to keep itself productively busy.

100-Mbps Token Ring.

What sort of enhancements will IBM make to ETR? One of the original concepts embodied in Token Ring was a preemptive prioritization scheme involving priority bits and reservation bits in each token, or frame. ETR destroyed this scheme. Each new token created during ETR carries the priority and reservation bits of its predecessor token. A workstation that tries to reserve the use of the ring by setting the reservation bits in the current data frame will be too late; the new token will already have been sent out onto the LAN, and it might be claimed by another node before the reserving workstation can grab it.

IBM will use a prioritization scheme in its 100-Mbps Token Ring product that is similar to the one specified in the Fiber Distributed Data Interface. Each device on the ring will be classified as asynchronous (i.e., devices that are not rigid about the time intervals that occur between network accesses) or synchronous (i.e., devices that have stringent timing requirements regarding their accesses to the network).

As you'd expect, a mainframe on a Token Ring will get a higher priority in this scheme. What other nodes will you designate as needing priority access to the LAN? Two come to mind instantly: file servers and database servers.

I'm tempted to speculate about "OS/2 NetWare," "RISC System/6000 NetWare," and the future fate of Microsoft LAN Manager, but I'm out of space. Look for more on those products in the coming months.

Next month, Bruce Shatzman and Jeff Lubeck examine LAN Manager 2.1's ability to coexist with NetWare, and they describe a few tricks for successfully integrating LAN Manager servers in a NetWare environment. ■

Barry Nance is a consulting editor for BYTE. He manages a 70-node NetWare LAN. He is the editor of the IBM Exchange and moderator of the lans conference on BIX, where you can reach him as "barryn."

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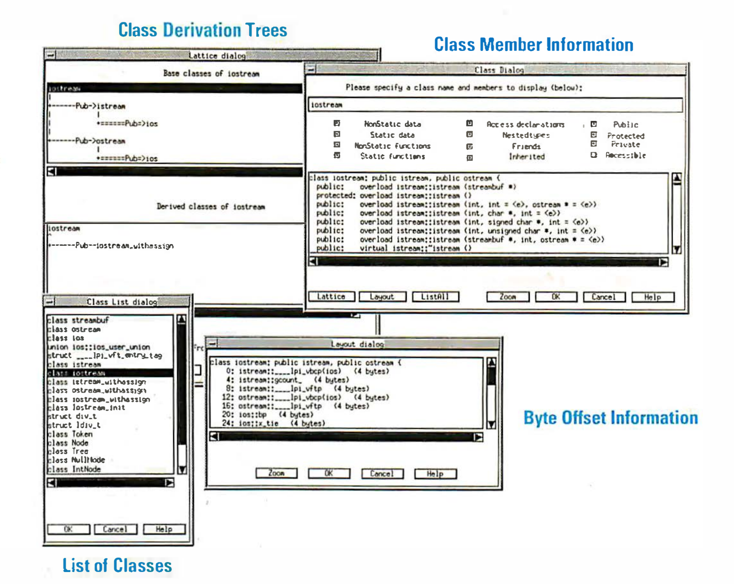
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FastFaxts 4227-010



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PC-lint 5.0 is the leading C diagnostic facility for finding bugs, glitches and inconsistencies that your C compiler, working on one module at a time, will miss. PC-lint with over 400 messages and 100 options is extraordinarily powerful and fully customizable. New features include a flow-control analysis to catch possibly uninitialized variables and programmer--controllable typedef--based strong type checking. Contains special checks for Windows debugging. Supports full K&R and ANSI C standards, and is the perfect add-on to your Microsoft C compiler.

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FastFaxts 53-009



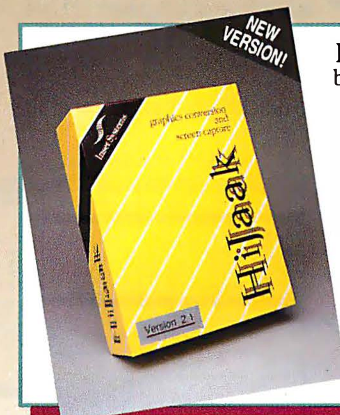
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by Inset Systems Inc.

HiJaak 2.1 is a graphics conversion and screen capture utility that translates more than 43 graphics file formats such as GEM, PICT I&II, CGM, DRW, HPGL, PIC, DSF, PCS, MAC, TIF, and supports more than 25 group 3 fax device formats. 5K pop-up provides capture function of both text and graphics screens, including Windows 3.0 screens.

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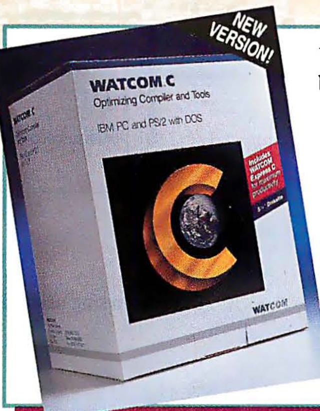
CLARION Prof. Dev.V2.1	845	475
Clipper 5.0	795	570
dBASE IV	795	549
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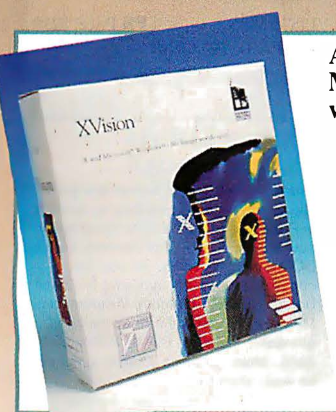
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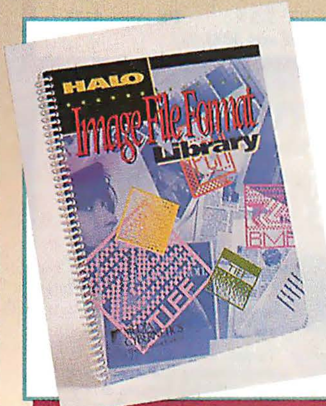
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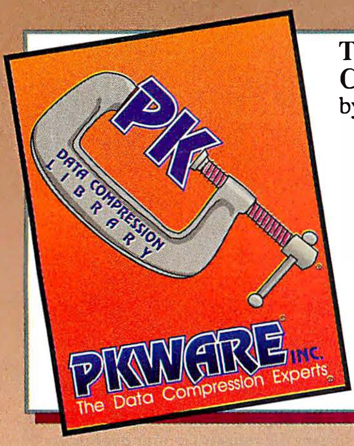
Borland C++	495	379
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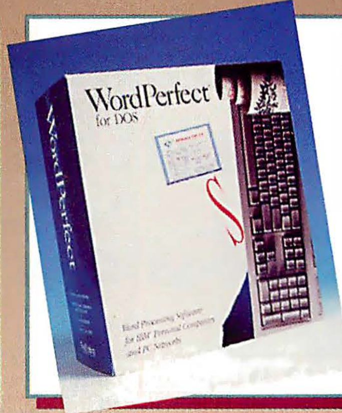


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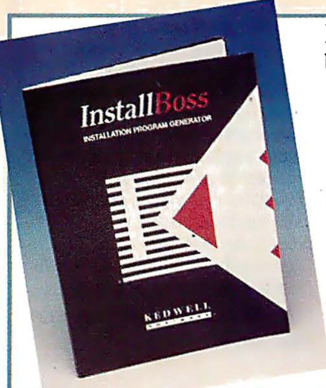
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Installation for program generator for MS-DOS based computers. It generates professional installation programs and procedures for your software application. InstallBoss is menu-driven and uses a compression utility, and checks Config.sys and Autoexec.bat files. Prepares distribution diskettes for easy installation.

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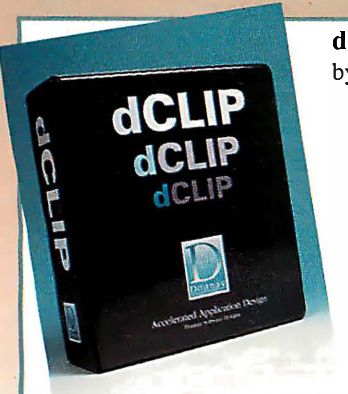


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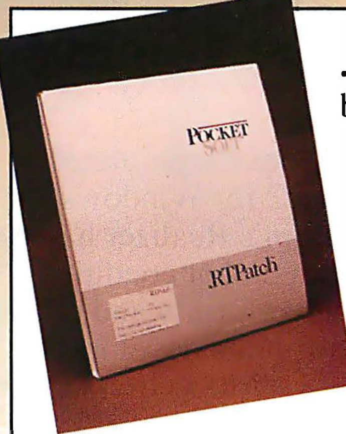
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by Information Architects, Inc.

Bsupport is a family of products for Novell's Btrieve record manager. Bedit displays, edits, and manipulates any Btrieve file. Banalyze is a TSR Btrieve application debugger. Brun replaces BUTIL and includes run-time license and C source. Bcreate builds file definitions easily and quickly. Toll-free tech support and BBS.

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by Pocket Soft, Inc.

.RTPatch allows you to update files or entire systems by sending only the changes between versions. .RTPatch compares the old version of a file (or set of files) to the new version, and creates a small patch file that contains just the differences. This patch file is then sent to the end user. The patch file is then used to change the end user's old version into the new one.

The advantages of patching are numerous: Patches are typically very small and therefore use less disk media or BBS time. Patches are also very easy to create and apply, thus taking the hassle out of updating. Patches can also be posted on public BBS's without fear of theft since the patch is useless if you do not have an original copy of the program. Finally, patches are very safe. Extensive verification insures that a correct patch is created and applied.

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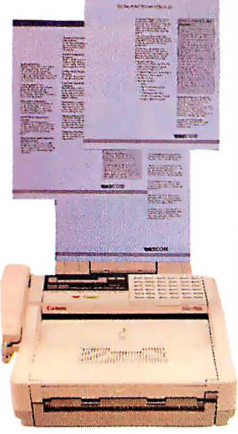


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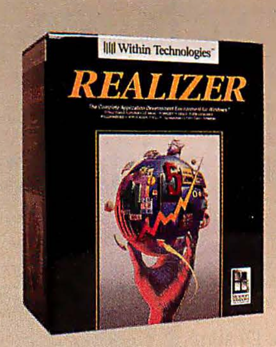
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REALIZER was presented with the BYTE Magazine/Interface Group "Best Rookie Exhibitor" Award at the Spring 1991 Comdex/Windows World show, prompting BYTE editor Jerry Pournelle, in his September 1991 column, to write that "REALIZER looked to be a better program ... certainly easier to use ... than Visual Basic."



" . . Visual Basic may have legitimized the idea of using BASIC for Windows development, but Within's Realizer has met the competition under combat conditions and demonstrated the versatility and robustness demanded by corporate developers."
- Peter Coffee, **PC Week**
September 9, 1991

" . . You've heard of Microsoft's Visual Basic, but a much more powerful environment you should try is Within Technologies' Realizer . . ."
- Brian Livingston, **InfoWorld**
October 14, 1991

" . . a Windows programming breakthrough . . ."
- Kaare Christian, **PC Magazine**
October 15, 1991

" . . no other Windows BASIC can match it for power and breadth of features . . ."
- Paul Bonner, **PC Computing**
October 1991

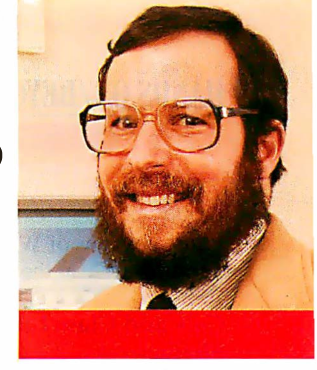
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MARTIN HELLER

OLE FOR WINDOWS 3.1

Oh, what horrors have I seen in that chamber.—James Joyce

Being a beta tester is both good and bad. You get to suggest things that would be useful to you in the final product, but you have to put up with the inevitable horrors—bugs and synchronization problems. If you use one beta program, fine—you can keep that under control. But I'm currently running test versions of Windows, Word for Windows, and Borland C++. It gets out of hand. Not that any of these is bad—no, I wouldn't go back. But I've been rebooting my computer too often. And I sometimes must go back to previous versions for compatibility with other programs.

The New Windows

You'd think that Windows 3.1 was a minor upgrade from Windows 3.0. Superficially, it is: It's faster and more robust, and it comes with better utilities and better type. Under the surface, though, are some major changes. For instance, Windows 3.1 has Object Linking and Embedding (OLE) built in.

Big deal, you say? It is a big deal when you realize that Write can now automatically launch PC Paintbrush to revise a drawing. And it's a big deal for the programmer who has to do the work of updating an application to support OLE—there are about 100 new OLE functions. Just when you thought you understood Dynamic Data Exchange!

Speaking of which, there is now an easier way to implement DDE, a set of libraries called DDEML. This implements the protocol-using functions and call-backs that insulate you from handling DDE messages directly.

TrueType makes an obvious difference in Windows 3.1. More fonts are available, they can be scaled to any size and rotated to any angle, and they look the same on the screen as on the printed page. TrueType requires a little work from applications developers—half a dozen new calls are needed to completely support TrueType.

Drag-and-drop functionality makes it easier to get programs started with specific data. For the developer, adding drag-and-drop support is nearly free. There's one function call to tell Windows you can handle dropped files and one message to process when the files are dropped. You'll soon see more consistency in the commonly used dialog boxes in Windows 3.1.

Before this, developers had to reinvent everything, even the dialog box for opening a file. Now there are reusable dialog-box functions for color selection (RGB and hue-luminance-saturation models), font selection, filename selection (open and save file dialog boxes), finding and replacing strings of text, and printing (both configuring a printer and controlling a print job). What a concept—and about time, too.

Windows 3.1 APIs, C++ libraries for Windows, and hard drive adventures



Writing shells is easier now, too, with documented functions for pulling icons out of .EXE files, for finding out about the program inside an .EXE file, and for automatically opening or printing a data file using the appropriate program. Alas, the shell side of drag-and-drop is not yet documented.

Writing Windows debugging functions and programming tools is now much easier because of about 100 new "tool help" functions. Developers can use 10 new "stress" functions to test their applications in reduced-resource situations, so the programs you see will be less likely to fail in use. And the Windows kernel itself is much fussier about what it accepts from application programs, so it is less likely to crash because of a badly behaved program. It's a brave new world.

There are other ways for developers to improve their programs before shipment. Testers can run an application named Dr. Watson, which records the conditions that lead to the dreaded unrecoverable applications error. Send your Dr. Watson logs back to the developer, and chances are the problems can be fixed, even if they don't reproduce on the developer's machine. Earlier in the game, developers can use a special "strict" version of WINDOWS.H to double-check their code at compile time.

Developers who want to get ready for Windows NT and Win32 (Microsoft's next-generation Windows environments) can (and should) change the way they handle Windows messages. The new "message cracker" application programming interfaces (APIs) in version 3.1 automatically pick apart Windows messages and call message-handling functions with the correct parameters. This cuts down on the amount of ugly casting programmers have to use now and guarantees portability with

future versions of Windows, which won't be compatible at the raw-message level.

C++ and Class Libraries

Message-handling functions sound a lot like what the object-oriented folks call virtual methods. I don't think that's an accident. Microsoft is working on C++ for version 7.0 of its venerable C compiler, along with base classes for every environment the company supports. I haven't seen it yet (I'm still using version 6.0b for my production programs), but I do have a retail version 3.0 of Zortech C++ and a beta version 3.0 of Borland C++. I also have Watcom C 8.5 and MetaWare High C 2.3; I'll talk more about those in an upcoming column.

The Zortech compiler package is an outstanding value for multiplatform work. It supports DOS, OS/2, Windows, Presentation Manager, 286 DOS extenders, and 386 DOS extenders. It has a dynamic overlay technique for DOS, a handle pointer type for virtual memory management, and a royalty-free 286 DOS extender.

Zortech's compiler—which does global and local optimization—is the first to support the new Numerical C Extensions Group standards for floating-point operations and the first PC compiler to support the revision 2.1 C++ specification.

The scientific and engineering version of the Zortech compiler package also includes the M++ class libraries, which make handling vectors and matrices a snap. If you are still using FORTRAN because of the availability of LINPACK and EISPACK, this may be the time to switch to C++.

On the other hand, Borland C++ is the fastest compiler for developing DOS and Windows programs. Version 3.0 is even faster than version 2.0—there's no longer any perceptible penalty for writing C++, and, miraculously, the compiler now optimizes without a significant cost in compilation speed.

Borland's application frameworks—Turbo Vision for DOS programs and ObjectWindows for Windows—will give any developer a flying start at a working program with a good interface. I was quite surprised at how much Borland included in Turbo Vision—there's enough here that you can make your program look exactly like it was developed at Borland, with no trouble at all.

ObjectWindows is good, but it's not complete. Third-party class libraries like Win++, Tier, Zinc, and C++/Views have additional functionality. Which should you choose as an application framework?

Tough question. A more fundamental question is: Why use C++ and a class library at all? Aren't all the major Windows programs written in C using the Software Development Kit? Well, yes, they are—or were, until recently. Consider: A DOS "hello, world" program in C is five lines long, but the Windows equivalent in C is 80 lines long—and in three separate files, at that. "Hello, world" in C++ without a class library takes about 275 lines of code; with ObjectWindows, it takes 28 lines, and that includes white space. That's a big difference.

The other class libraries show roughly the same kind of dramatic simplification in the "hello, world" application, so that's not a reason to choose one over the other. You'll find the differences when you get deep into your project: differences in coverage of the API, ability to go directly to the API, availability of source code, completeness of documentation, and so on.

If a library doesn't let you go directly to the Windows API and doesn't support what you want to do, you'll have to add a class to the library. This may not be easy

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unless source code is supplied and the documentation is good. If a library does allow API calls, things are a little simpler. Now you're writing C again. The best case is a library that already has C++ classes built in for everything you want to do.

Another issue is integration of the classes, both within a library and between libraries. For instance, you might want to save a program's current state. If all your classes are streamable, that's easy—almost trivial. If not, well, it isn't impossible, but it's a lot of work.

I'm not going to attempt to list the coverage of each library. Even if I had the space, the list would be obsolete in a few months. I will, however, spotlight individual class libraries in my next few columns. Meanwhile, you may want to contact the class library vendors yourself. Most of these vendors have literature that includes their class hierarchy tree, so you can compare coverage and organization among libraries.

Alarums and Excursions

A few months ago, one of my ESDI hard drives developed the alarming habit of spontaneously spinning down and dumping its heads. Click-thunk, and suddenly DOS wouldn't be able to see the D partition table. Usually, a reboot would fix things. The problem seemed worst in the morning, but leaving the machine on all the time didn't help. I was seriously concerned that one day it would spin down and never power up again.

I got religious about doing my backups and realized that my 60-MB cartridges were not ideal for backing up a gigabyte of material. It took me all day to do a single set of backups, and I wasn't about to make multiple sets. With a little push from folks on BIX, I bought a bottle of Stabilant 22a. I cleaned and treated the drive cables; better, but not fixed. I treated the hard drive controller card's edge connectors and all the socketed ICs; better, but still not fixed. Finally, I dripped some Stabilant into the ribbon cable connections inside the drive case. Eureka! I've had no more trouble.

One down, one to go. I cast out my old tape drive and borrowed a 1.3-gigabyte digital audiotape drive from Palindrome (Naperville, IL), along with its Network Archivist 2.0 software. I've never had so much archival coverage for so little effort. I run Network Archivist at lunchtime, and when I come back it's done. It manages save sets, checkpoints, and migration archives using rule sets and a Tower of Hanoi algorithm—all the storage management procedures you'd find at a well-run mainframe shop. It even tells you which tapes to move off-site and when to bring them back. I don't want to give this back. Oh, my poor budget!

Signing Off

I mentioned earlier that I have a beta version of Word for Windows. It's version 2.0, and it's mostly wonderful. I'm using it to write and produce the camera-ready copy for *Advanced Windows Programming*, which should be on the bookstore shelves by the time you read this. ■

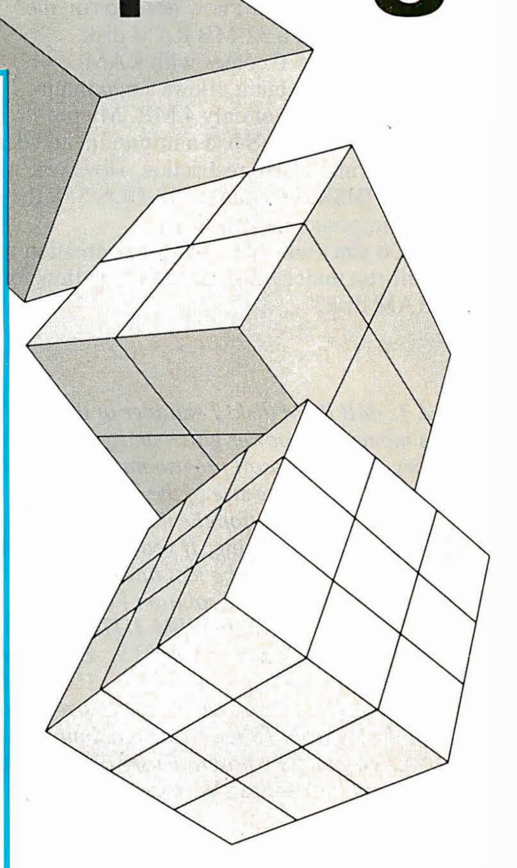
Martin Heller develops software and writes about computers, despite a Ph.D. in physics and having worked, literally, as a rocket scientist. He is the author of Advanced Windows Programming *(Wiley, 1992). You can reach him on BIX as "mheller."*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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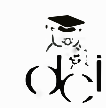
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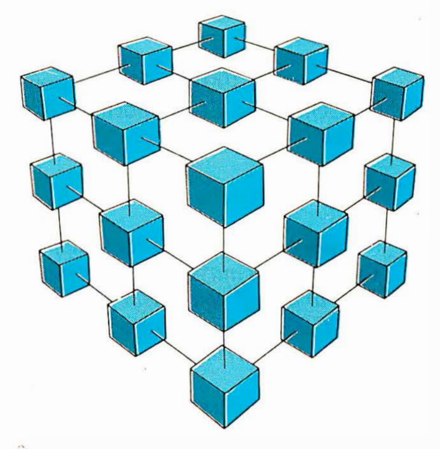
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A Really Big Disk

A serious problem with MS-DOS 5.0 has reared its ugly head. I need a large RAM disk for an application. To this point, I have been using DOS 3.3+ and VDISK.SYS 3.08 to create an 8-MB RAM disk. I now need to run the application in a 32-MB RAM disk.

MS-DOS 5.0 comes with RAMDRIVE.SYS, but it allows a maximum RAM disk size of only 4 MB. My previous VDISK.SYS had a minimum and default, but it had no maximum size restriction. However, when I tried to run VDISK.SYS under MS-DOS 5.0, the operating system imposed a 4-MB limit.

Do you know of a RAM disk creation program that will run under MS-DOS 5.0 and allow for a 32-MB RAM disk?

T. Pappan
Owosso, MI

A 32-MB RAM disk! I shudder at the very thought of it. A momentary power glitch and your data would be history. The Microsoft programmers had a reason for putting a limit on the size of the RAM disk.

You didn't mention the nature of the application program you are running. If you can, invest in a caching hard drive controller and a fast hard drive.

The only software solution I could find is an ADJRAM41.ZIP file in the IBM.UTIL listings section on BIX. The .ZIP file includes the .SYS, .EXE, and .DOC files, plus source code in C and ASM. ADJRAM is an adjustable RAM disk. You can vary the size of the RAM disk on the fly from 15 KB to the maximum available RAM in your system. The program uses only expanded memory.

Good luck.—Stan Wszola

Any Port in a Storm

I just read "Repairing the Cracks in Windows" in the September 1991 BYTE. Version 3.0 does not support the COM3 and COM4 ports. Will Windows 3.1 support them?

Chris Crosby
Plano, TX

Windows 3.0 certainly does *support COM3 and COM4. Your problem may be that you haven't configured Windows to use all your COM ports. First make sure that all your COM ports are configured for the correct I/O address and interrupt:*

Port	*Address*	*IRQ*
COM1	*3F8h*	*4*
COM2	*2F8h*	*3*
COM3	*3E8h*	*4*
COM4	*2E8h*	*3*

You may have four serial ports, but they share two interrupts. You can run into problems if, for example, you are using a serial mouse on COM1 and have an internal modem on COM3. This configuration won't work because the mouse is tying up the interrupt that is shared with COM3. This also occurs if you are using a serial mouse on COM2 and want to use an internal modem on COM4.

COM3 and COM4 may not work reliably under Windows 3.0 (in standard and real modes) unless both COM1 and COM2 are first activated. Don't use a higher serial port (i.e., 2, 3, or 4) unless all lower number ports (i.e., 1, 2, and 3) are first activated or in use.

You should also check the default setting in the 386ENH section of the SYSTEM.INI file for proper functioning of the ports under enhanced-mode Windows 3.0:

COM1BASE=3F8h
COM2BASE=2F8h
COM3BASE=3E8h
COM4BASE=2E8h

The procedure for modifying the SYSTEM.INI file is described in detail in the SYSINI2.TXT file. The discussion appears in the 386ENH section.—Stan Wszola

Yankee Doodle Deadly

After I returned a defective shareware disk to a distributor, I learned that it contained the Yankee Doodle virus. I have not been able to obtain a copy of Richard Levin's *Computer Virus Handbook*, which Hugh Kenner mentioned in the November 1990 Print Queue. Is there somewhere I can find out about this computer virus?

C. J. Jaskowiak
Skokie, IL

The Yankee Doodle virus is a fairly common strain affecting IBM PC compatibles. Infected .COM and .EXE files generally increase in size from 2772 to 2899 bytes. There are many versions of the virus, the most common of which plays "Yankee Doodle Dandy" on the PC's speaker at 5:00 p.m. For this reason, it's also known as the Five O'Clock virus.

Computer Viruses *by David J. Stang (Diane Publishing, 1991, ISBN 0-941375-24-2) lists some in-depth information about this virus, starting on page 315. Stang and Bill Bales head the National Computer Security Association (227 West Main St., Mechanicsburg, PA 17055, (717) 258-1816). The NCSA conducts seminars and provides information about computer security and virus protection.*

The NCSA's booklet Computer Virus Survival Guide *explains how to prevent, detect, identify, and recover from viruses. You can get a copy for $7. The NCSA also has a BBS you can call for more information: (202) 364-1304, 8 bits, 1 stop bit, no parity.*

We recommend a complete program of security and virus prevention if you are concerned about the virus threat. For a review of security and virus-prevention software, see the Solutions Focus in the August 1991 BYTE.—Stanford Diehl

Ins and Outs

I am looking for information on IBM PC/XT/AT/386 hardware interfacing (i.e., RS-232, Centronics, I/O bus, mouse, and video adapters). Is there a single source? Specifically, I want to use the Centronics parallel printer interface for general I/O.

Gilbert Mackay
Middlesbrough, U.K.

Programmer's PC Sourcebook, *2d ed., by Thomas Hogan (Microsoft Press, 1991, ISBN 1-55615-321-X) should have everything you need. It includes complete hardware specifications for PC components, peripherals, and ports.*

By a grand coincidence, Howard Eglowstein has written about using the Centronics parallel printer port in this month's Some Assembly Required. He has created a TSR program for a notebook computer that accepts keystroke information from a desktop machine and posts it in the notebook's keyboard buffer. A companion program for the desktop machine accepts keystrokes and passes them through the parallel cable. This article should give you some good ideas.—Stanford Diehl

A DISKussion on TSRs

As a computer analyst, I have a lot of experience with computers, mainly IBM PC compatibles. Until now, I've written only "safe" applications using dBase, Pascal, or C. I taught myself assembly language, and then I wrote a small TSR program to see how it works. My TSR redirects INT 17 hexadecimal (i.e., BIOS printer request) to the screen (or a file). I managed to redirect the printer output to the screen, but when I tried to send the output to a file, it stopped working. I tried everything, and I'm stuck. Is it the famous DOS reentrancy problem? Can you suggest a solution or a reference for more information?

Albert Ivanov
Fléron, Belgium

Well, you didn't try quite *everything. You have in fact stumbled into the DOS reentrancy problem, and working around it is one of the trickiest TSR problems in DOSdom. Master that, and you're well on your way to being a DOS wizard.*

The problem is this: DOS is not an operating system as much as it is a collection of utilities. If you think of the file system as a utility for handling disks, it's easy to see why Microsoft didn't build in support for multiple tasks. There simply was no reason to do so. Once DOS starts a task, you have to let it finish before asking it to do something else. The reason your TSR crashes is that it often tries to do disk access during another DOS call. The disk call wipes out the status of the interrupted call, and DOS goes away.

The workaround is conceptually simple. Before you make your DOS call, ask DOS if it's busy. If it is, exit the TSR to let DOS finish what it's doing and try again later. To do that, you need the assistance of a "secret" DOS call that was largely undocumented until version 5.0. During your TSR installation process, call INT 21h, function 34h. DOS will return ES:BX as a pointer to the

InDOS flag. Your TSR can check the contents of this byte to see if DOS is free.

The correct way to have a TSR capture the printer output to a file is along these lines: The TSR has to capture two interrupts. Obviously, you have to capture INT 17h, the printer interrupt. Your new INT 17h will take the characters and start them on their way to the file. Buffer up a bunch of them, and when you're ready to save them, your TSR should check the InDOS flag. If it's zero, it's safe to call DOS. Temporarily take over INT 24h (the critical error handler), so any disk errors don't plop an "Abort, Retry, Ignore?" message on-screen. Open your file, seek to the end, write the data, and close the file. Restore the critical error handler.

If the InDOS flag has a nonzero value, you're stuck. You'll just have to hold the characters in memory and wait until you get control next to try again. I'd suggest that you daisy chain to INT 1Ch (the 18.2-tick-per-second clock). By examining the InDOS flag 18 times each second, you're going to find DOS available more often than by merely using INT 17h.

That's a lot to do, and you're going to crash the machine frequently while you debug it. The new Microsoft MS-DOS Programmers *(Microsoft Press, 1991, ISBN 1-55615-329-5) has a brief discussion of the procedure. You might also see Andrew Schulman's* Undocumented DOS *(Addison-Wesley, 1990, ISBN 0-201-57064-5) for more information on the InDOS flag. If you can still find a copy, check out the* Waite Group's MS-DOS Papers *(ISBN 0-672-22594-8). It's a collection of articles by various authors on the scarier parts of DOS programming. Their discussion of TSR file access is excellent.*

—Howard Eglowstein

EISA or ISA

I am looking for a 33-MHz 386 or 33-MHz 486 EISA motherboard to update my present 286 computer. A vendor that I visited had an EISA board with both EISA and ISA slots. I wondered if the EISA slots on this board really work at full speed.

At another computer store, I was told that it's motherboard had two EISA slots, but that these operate at only 12 MHz. At what speed should EISA slots work? If I mount an ISA card in an EISA computer, does the EISA bus still work at full speed?

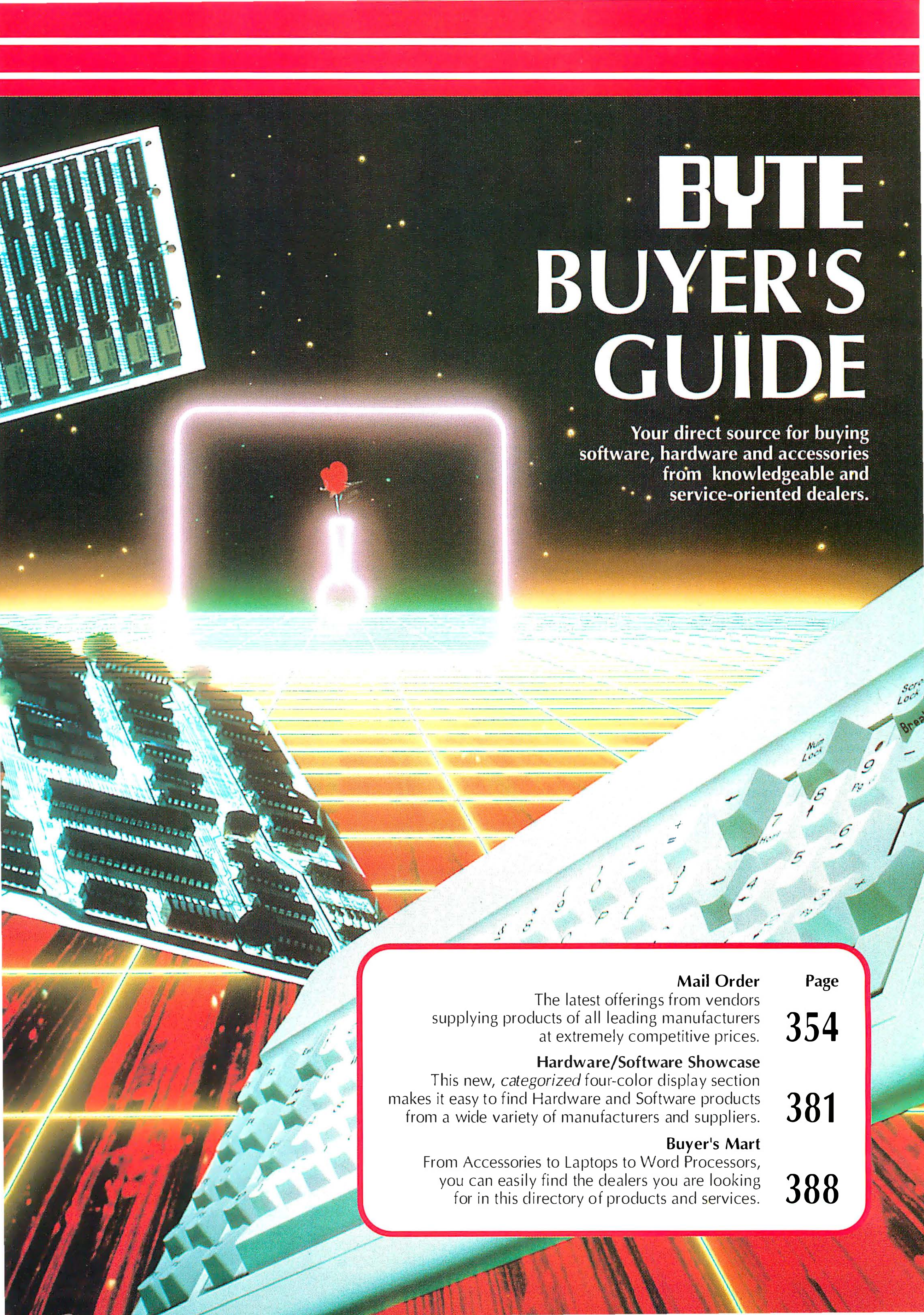
I have several ISA cards in my computer that I would like to move to my new motherboard. Are there any problems using old 8-bit cards in EISA slots?

Carl Nilsson
Lund, Sweden

One of the purposes of EISA was to provide a high-performance bus standard that maintained compatibility with the great majority of devices designed for the ISA bus. Systems we've seen run the EISA bus at 8 MHz, so using your old 8-bit cards should be fine. Their presence should not affect the performance of other peripherals.

Some motherboards partially implement EISA as a way of saving money or as a stepping-stone design between full-ISA and full-EISA systems. Whether you choose full-EISA or a partial design, you shouldn't have any trouble with cards that work reliably in IBM ATs.

—Steve Apiki ■


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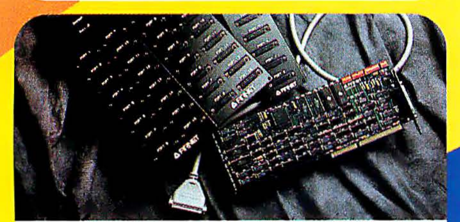


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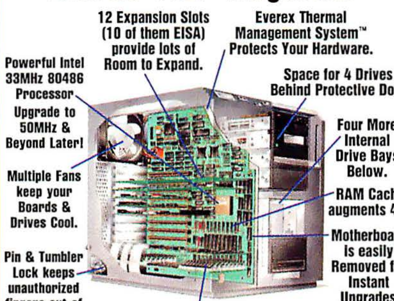
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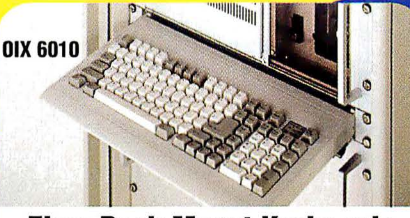
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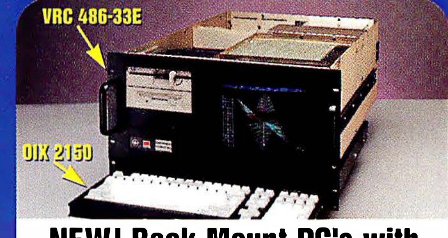


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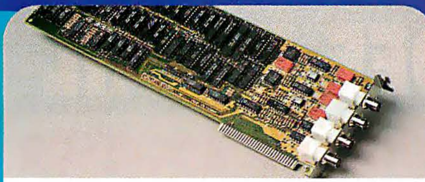
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#VRC 386-16S VGA Rack-Mt. PC, 80386sx, 16MHz **$3595**
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DATA ACQUISITION



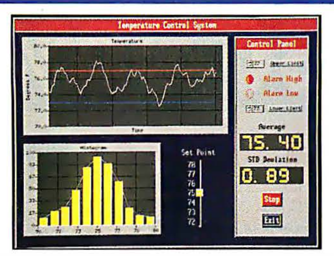
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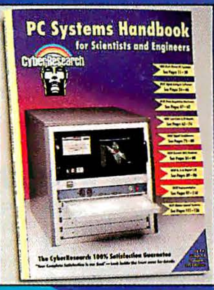


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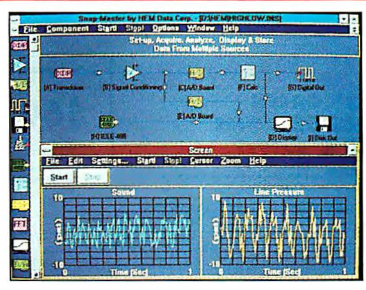
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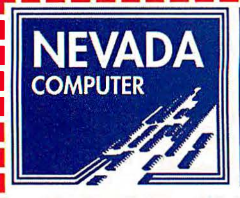
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ST157A	44MB	28MSEC	IDE	174.00	204.00
ST251-1	42MB	28MSEC	MFM	229.00	289.00
ST296N	85MB	28MSEC	SCSI	299.00	439.00
ST1096N	84MB	24MSEC	SCSI	349.00	489.00
ST3096A	84MB	16MSEC	IDE	299.00	339.00
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	OK BOARD	118700-001	98.00
386SX/20	4MB MODULE	118690-001	298.00
DESKPRO	1MB BOARD	108069-001	238.00
386/16	2MB BOARD	108069W71	348.00
	1MB KIT	108071-001	128.00
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	4MB KIT	108072-001	318.00
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386S	4MB BOARD	113634-001	328.00
	1MB MODULE	113646-001	98.00
	4MB MODULE	112534-001	268.00
DESKPRO	1MB MODULE	113131-001	88.00
386/20, 25, 286E	4MB MODULE	113132-001	228.00
DESKPRO	1MB BOARD	113644-001	148.00
386/20E/25E	4MB BOARD	113645-001	328.00
DESKPRO	2MB MODULE	115144-001	128.00
386/33, 486/25/33/33L	8MB MODULE	116561-001	639.00
SYSTEMPRO	32MB MODULE	116568-001	3950.00
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PORTABLE	512K KIT	107331-001	38.00
III	INTFC BD	107808-001	149.00
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	2MB KIT	107332-001	128.00
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PORTABLE	1MB KIT	107651-001	179.00
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64X4	1.95	2.25	2.45	2.95	
256X1	.95	1.05	1.10	1.15	1.95
256X4		3.95	4.45	4.95	5.45
1MEGX1		3.50	3.85	4.10	4.45

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TOSHIBA MODEL	MEMORY ADDED	TOSHIBA EQUIV. PART #	YOUR COST
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T1000SE & XE/LE	2MB BD	PC14-PA8312U	248.00
PORTABLE T1200XE	2MB BD	PC13-PA8306U	148.00
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PORTABLE T3100SX	2MB BD	PC15-PA8308U	148.00
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PORTABLE T3200	3MBBD	PC6-PA7137U	248.00
PORTABLE T3200SX &	2MB KIT	PC12-PA8307U	133.00
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PORTABLE T5100	2MB BD	PC7-PA8301U	148.00
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ZENITH MODEL	MEMORY ADDED	ZENITH EQUIV. PART #	YOUR COST
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	4MB MOD	ZA3800MK	298.00
Z386/25/33	1MB MOD	ZA3600ME	78.00
	2MB MOD	ZA3800MG	138.00
Z248, Z286LP, Z386SX	2MB MOD	Z-605-1	118.00
TURBO SPRT 386,386E	1MB KIT	ZA3034ME	168.00
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SX	2MB KIT	ZA180-86	189.00
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PS/280-111, 121, 311, 321	2MB MODULE	6450379	138.00
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256X9	9.00	14.00	17.00	26.00	29.00
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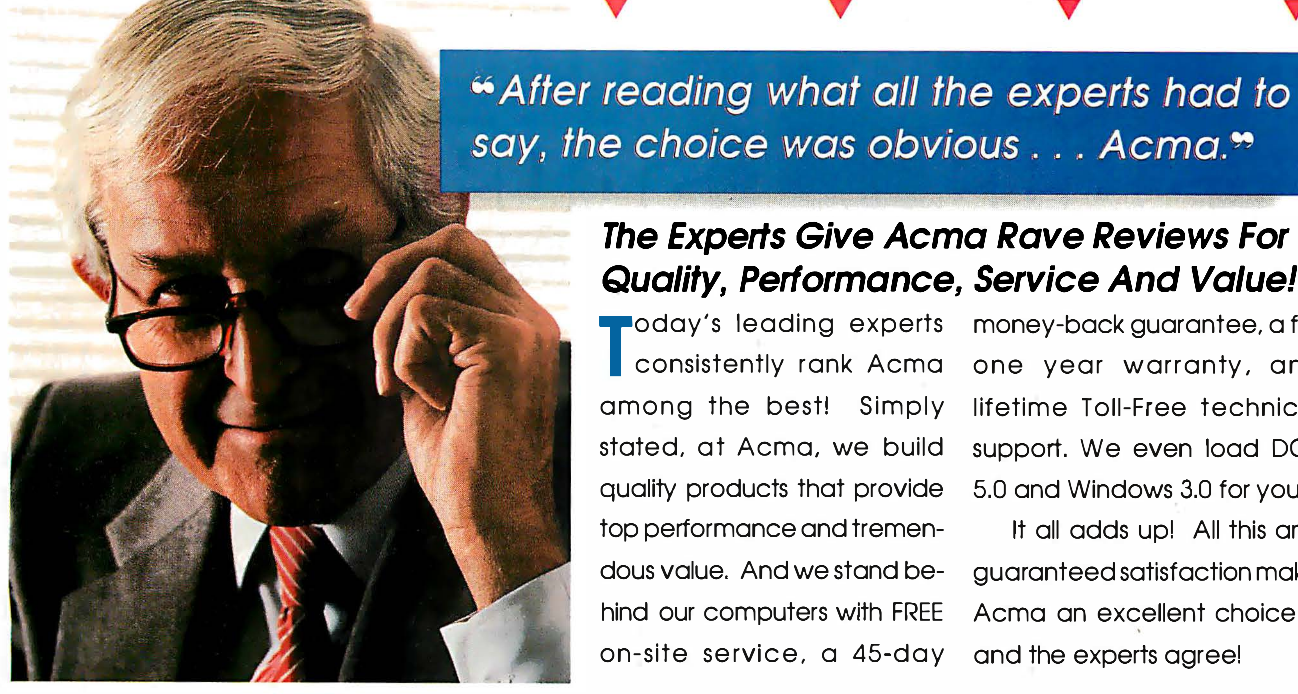
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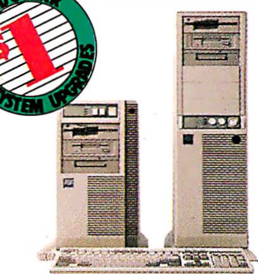
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For over seven years, we've been delivering; delivering service, price, and performance. Together, this means value for you. We start by building the best systems possible — using the best components available. Then each and every system receives a 72-hour burn-in and a comprehensive quality assurance review. The goal is to deliver 100% reliability. But if a problem ever does arise, we fix it — quickly and properly. Each system comes with a full one-year warranty, plus life-time toll-free phone support, plus all systems have a full 30 day money-back guarantee.

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From $1,699

- 4 MB RAM
- 90 MB hard drive with Cache
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- Super-VGA color monitor (1024x768)
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- Desktop or mini tower case
- 220 Watt power supply
- 101 enhanced tactile keyboard
- Serial mouse
- MS-DOS 5.0 plus data base, spread sheet and word processor

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BLUE STAR 486 SYSTEM

$2,449

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- Super-VGA color monitor (1024x768)
- 1 parallel, 2 serial, 1 game port
- Desktop or mini tower case
- 220 Watt power supply
- 101 enhanced tactile keyboard
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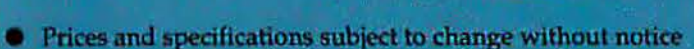
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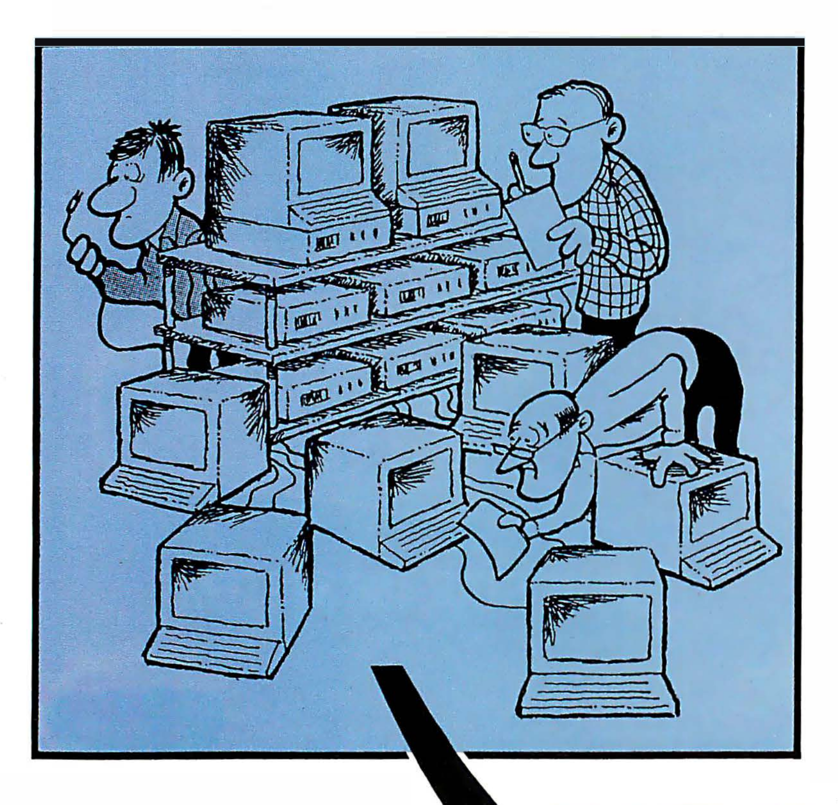




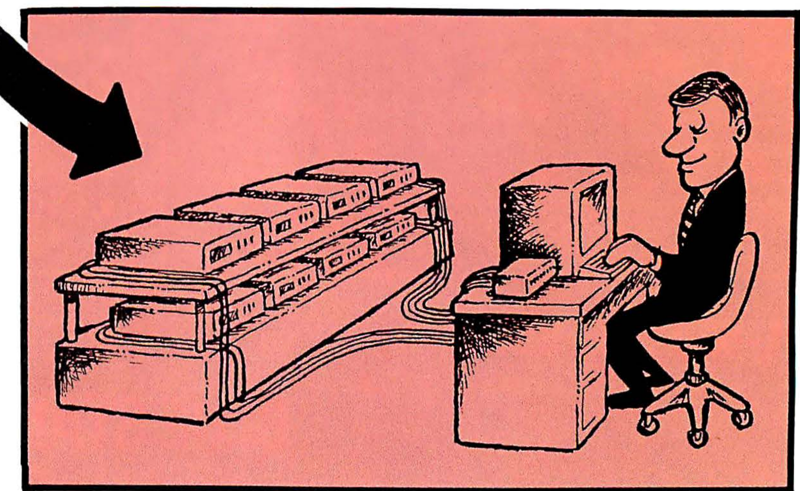
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Adaptec 1542 KIT Bussmaster	290
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MFM-AT Controller	76
MFM-XT Controller (8 bit)	57

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VGA Mono 14"	135

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TEXAS INSTRUMENTS	TM3000	40MB/6MB RAM	$2,518
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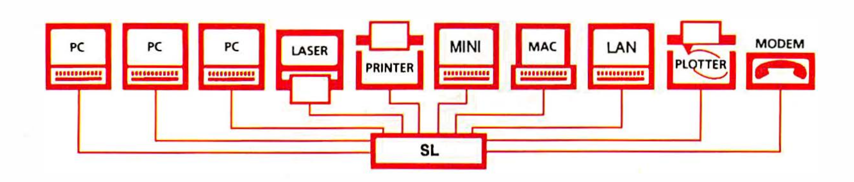
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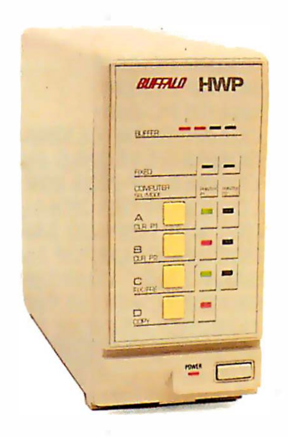
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HXM	4 2 Ser., 2 Par.	Any Combination	256KB - 16MB	Pop-up or Buttons	$295 / 256KB $395 / 1MB
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HWP	5 Parallel	3/2 4/1	256KB - 16MB	Pop-up or Buttons	$295 / 256KB $395 / 1MB
HXP	4 Parallel	2/2 3/1	256KB - 16MB	Pop-up or Buttons	$245 / 256KB $345 / 1MB
HCP	2 Parallel	1/1	256KB - 16MB	One Printer	$225 / 256KB $325 / 1MB
AS-41	5 Parallel	4/1	None	One Printer	$195
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Printers and other expensive peripherals are idle the vast majority of the time. Buffalo boxes facilitate efficient utilization of these devices, and reduce the need to purchase more of them.

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ABTECH 486/33
64K Cache

made in USA made in

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- Desktop Case w/200W P.S.
- 101 Enhanced Keyboard

$1,399

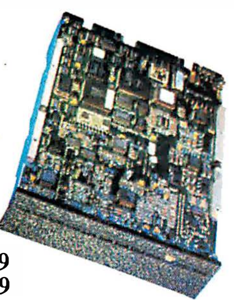


386/33 Mhz	$999
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Same standard feature as above

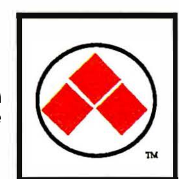
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The assurance of quality conponents in each ABTECH system



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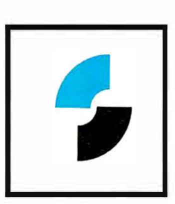


Option

Our trained technicians can provide solutions

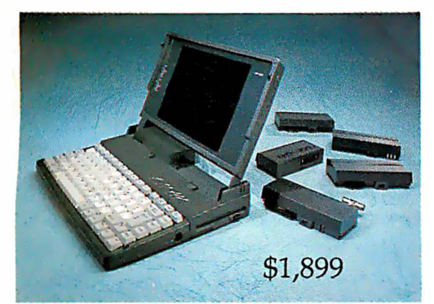


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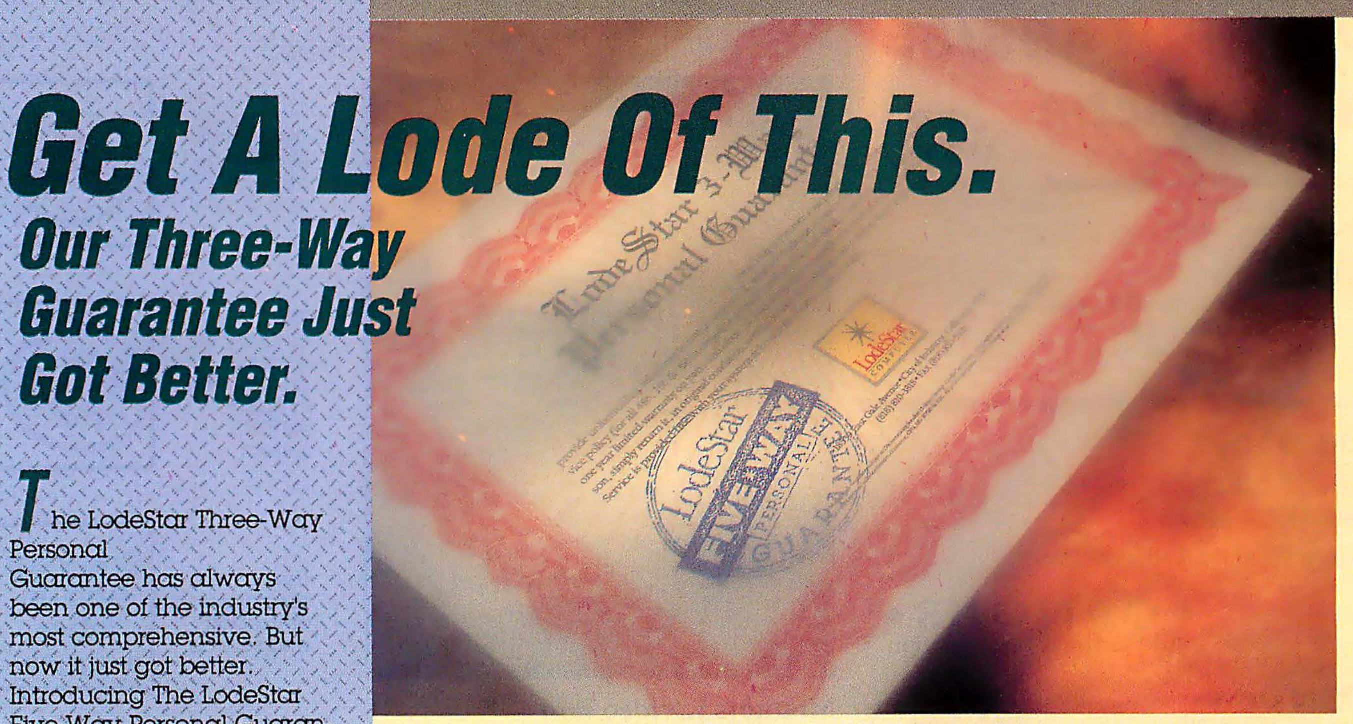
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1. **MONEY BACK GUARANTEE.** *If you change your mind-for any reason-simply return your LodeStar system to us in original condition within 30 days of your receipt andwe'll refund your money.*

2. **FREE LIFETIME TECHNICAL SUPPORT.** *For as long as you own your system, we'll give you FAST, FREE unlimited technical advice and guidance from our expert staff. This includes any support needed to upgrade or modify your system.*

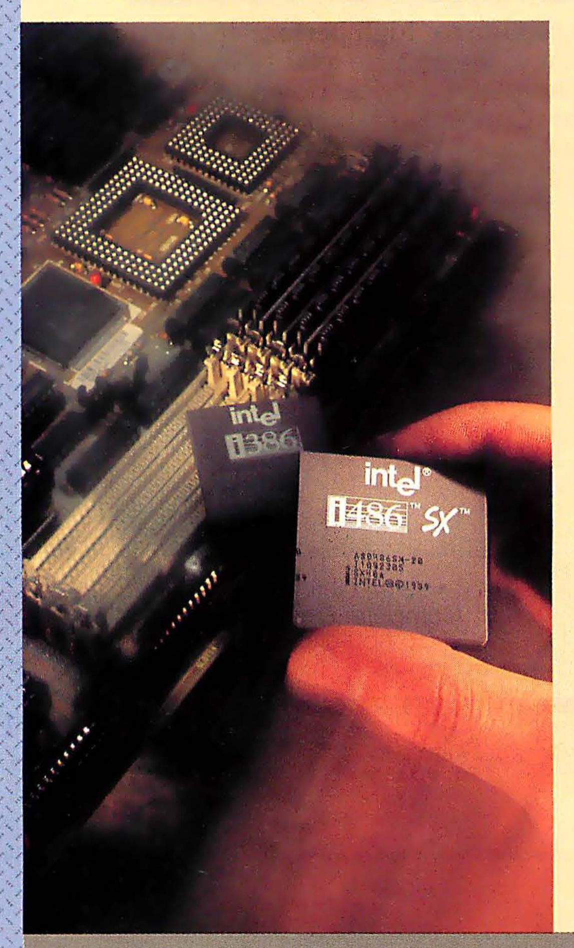
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4. **FREE 2-YEAR PARTS WARRANTY.** *For a full two years after purchase, your LodeStar computer will be covered by our 100% parts warranty, with fast turn around on any replacements.*

5. **FREE 1-YEAR ON-SITE SERVICE..** *For a full one year after purchase, you'll have the added security of our coast-to-coast FREE on-site service.*

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Easy and inexpensive upgrades are built right into your LodeStar computer. Unlike conventional modular upgradeable systems from other companies, you can upgrade your LodeStar system at a fraction of the cost-all the way from 386DX to 486SX or 486DX, at any clock speed.

Thanks to our unique non-proprietary Moduless Upgrade design, LodeStar systems can be upgraded by simply plugging in the new chip and oscillator that comes in their inexpensive upgrade kit. Another bright idea from LodeStar-It's just that simple!

Every LodeStar computer is fully loaded with value. This includes unsurpassed quality throughout. To make certain of this, every system is individually pretested and burned-in for 72 hours prior to shipment. And of course, we stand behind our quality with our comprehensive Five-Way Personal Guarantee. You will see this quality all the way from our StarView SVGA Non-Interlaced Monitors with flicker-free image, to our own StarKey extended keyboards. And we pack in even extra value by pre-loading MS DOS 5.0 & Windows 3.0, as well as a Hi-Res 400 DPI serial mouse on every system. And our systems can be upgraded to include optional cache, RAM, more hard disk capacity, larger monitor, and a host of other enhancements you may require. Add it all together - stellar performance, brilliant quality, and guarantee that outshines all others - and you've got LodeStar.



386 Systems

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125MB IDE Hard Drive with Cache
Teac 1.2MB 5.25" & 1.44MB 3.5" Drives
1MB SVGA Non-interlaced Color Card
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Flicker-Free Color Monitor
2 Serial, 1 Parallel, & 1 Game Port
MS DOS 5.0 & MS Windows 3.0
Starkey 102 Keyboard
Hi-Res Serial Mouse
Desktop CPU Case (Verticals optional)
Upgradeable to 40 MHz &
486sx 20, 486 33/50

386 40MHz
$2179

386 25MHz
$1879

Intel 80386/33 Processor
64K Cache RAM (Expandable to 256K)
4MB RAM (Expandable to 32MB)
85 MB IDE Hard Drive with Cache
Teac 1.2MB 5.25" & 1.44MB 3.5" Drives
1MB SVGA Non-interlaced Color Card
14" SVGA Non-Interlaced 1024x768
Flicker-Free Color Monitor
2 Serial, 1 Parallel, & 1 Game Port
MS DOS 5.0 & MS Windows 3.0
Starkey 102 Keyboard
Hi-Res Serial Mouse
Desktop CPU Case (Verticals optional)
Upgradeable to 33/40 MHz &
486sx 20, 486 33/50

386sx 16MHz
$1335

Intel 80386/16 Processor
2MB RAM & 42 MB Hard Drive w/Cache
Teac 1.2MB 5.25" & 1.44MB 3.5" Drives
1MB SVGA Color Card
14" SVGA 1024x768 Color Monitor
2 Serial, 1 Parallel, & 1 Game Port
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Starkey 102 Keyboard
Hi-Res Serial Mouse
Desktop CPU Case (Verticals optional)

386sx 25MHz
$1395

Case Options

Every LodeSrat system comes with four C.P.U. Case options: The Desktop, or the Mini, Mid or Full Vertical Cases.



486 Systems

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$2495

Intel 80386/33 Processor w/ 8KB internal
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125MB IDE Hard Drive with Cache
Teac 1.2MB 5.25" & 1.44MB 3.5" Drives
1MB SVGA Non-Interlaced Color Card
14" SVGA 1024x768 Non-Interlaced
Flicker-Free Color Monitor
2 Serial, 1 Parallel, & 1 Game Port
MS DOS 5.0 & MS Windows 3.0
Starkey 102 Keyboard
Hi-Res Serial Mouse
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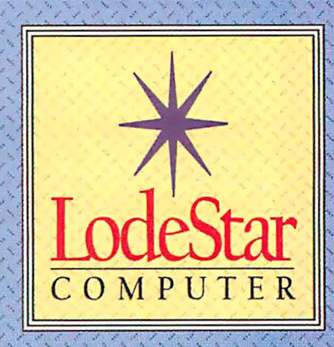
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486-33 ISA w/64k cache (MCI/Symphony) upgradable to 50MHz	$1,195
486-SX/20 w/64k cache (Symphony™)	$945
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386-25 (Symphony™) upgradable to 33MHz/40MHz	$745
386-SX20/16	$665/635
386SX-V20 Vanda NOTEBOOK 2MB RAM, 40HDD, 32-Grey scale mono VGA, 6.2 lbs.	$1,750
386SX-16 LAPTOP 2MB RAM, 40HDD, Mono VGA, 10.9 lbs.	$1,495

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- 64k Cache SRAM exp. to 1MB onboard
- 4MB RAM 70ns exp to 32MB onboard
- 1.2MB and 1.44MB Floppy Drives (TEAC)
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- SpeedStarPlus, 1MB,16-bit VGA card, Hi Sierra color
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- 1 Parallel/2 Serial Ports • Keytronics 101 Keyboard (USA)
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- 4MB RAM 70ns exp. to 32MB onboard
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- 52MB 17ms IDE Hard Disk Drive
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- Deluxe Baby Case with 200w UL Power Supply/6-bays
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DTC-3290 SCSI/EISA,512K	$575
Adaptec 1740B-Kit SCSI/EISA	$480
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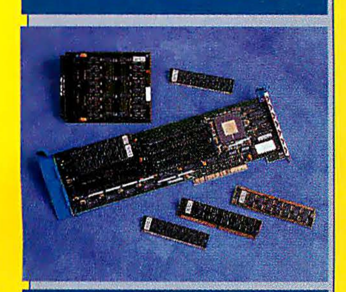
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2MB	6450608	$129
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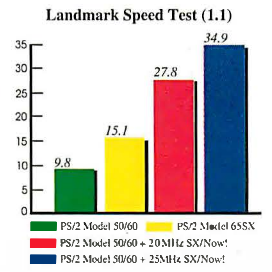
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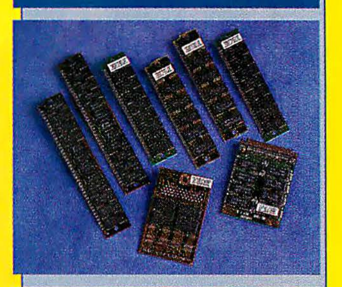
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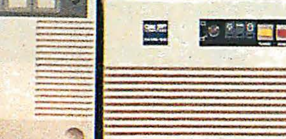
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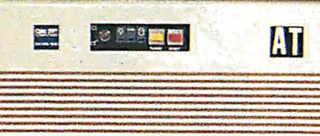
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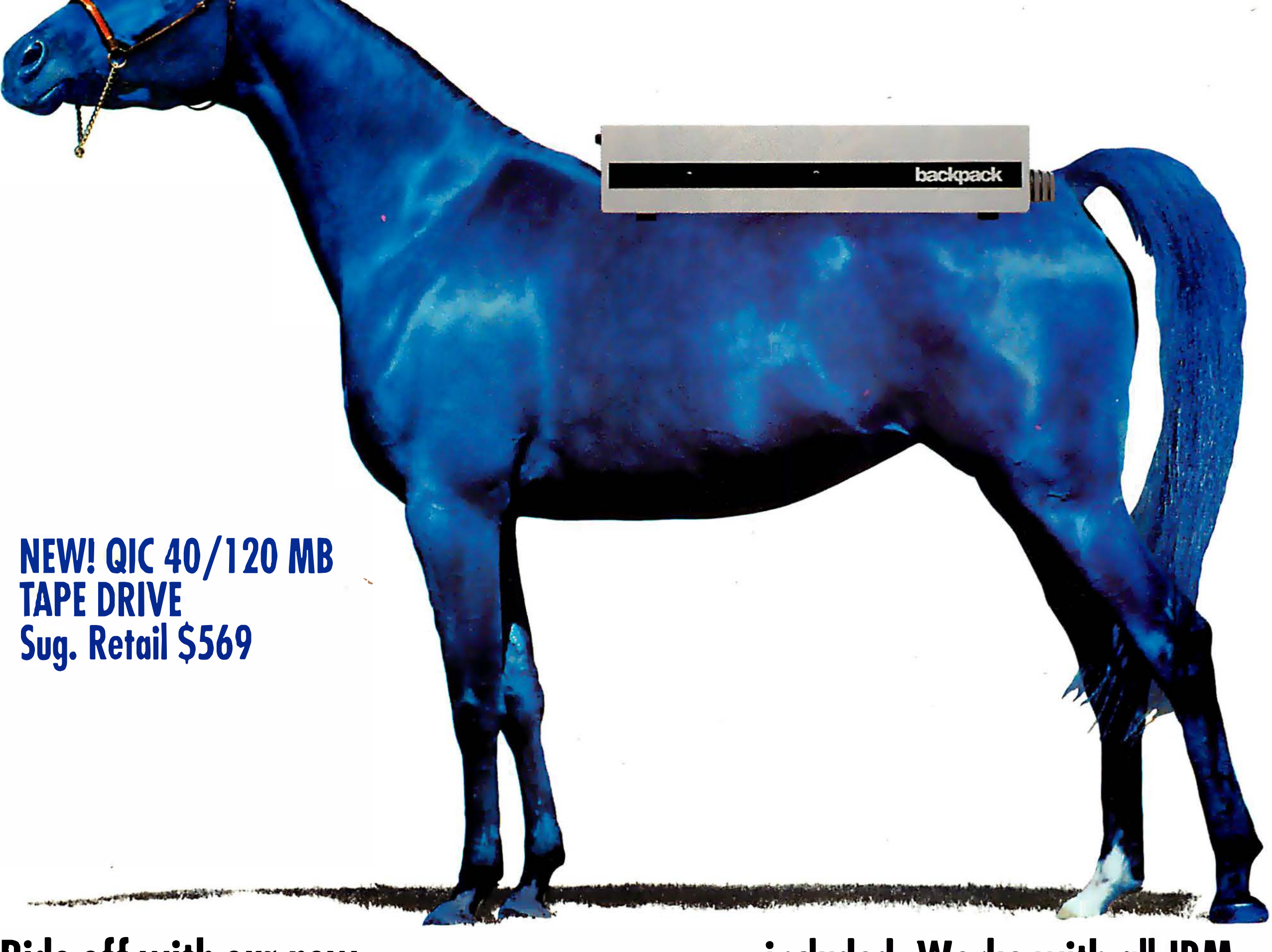


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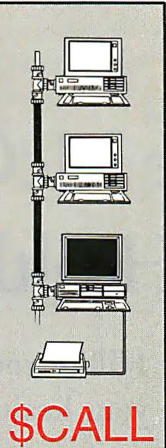
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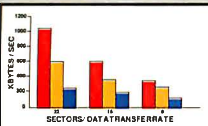
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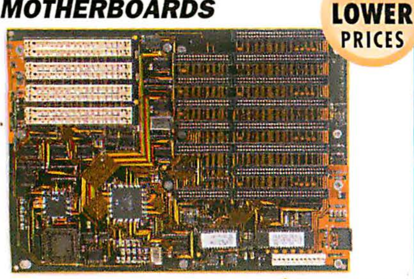
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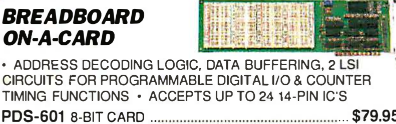
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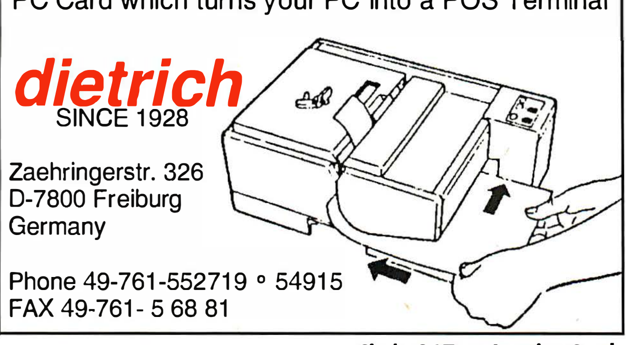
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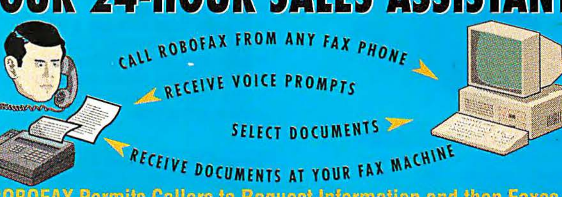
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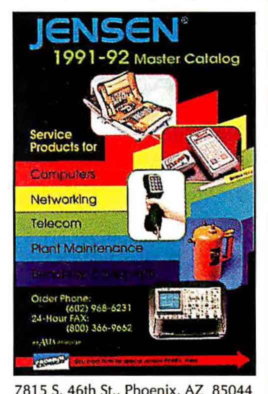
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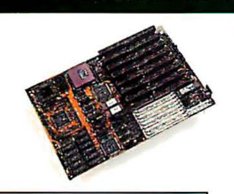
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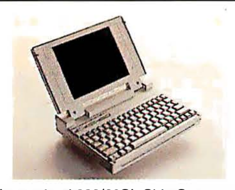
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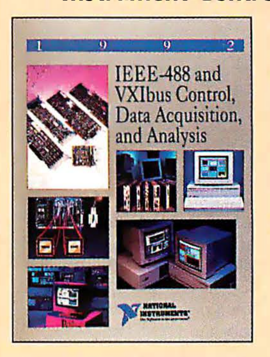
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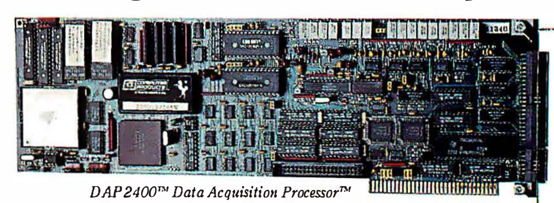
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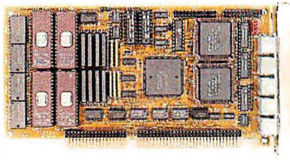
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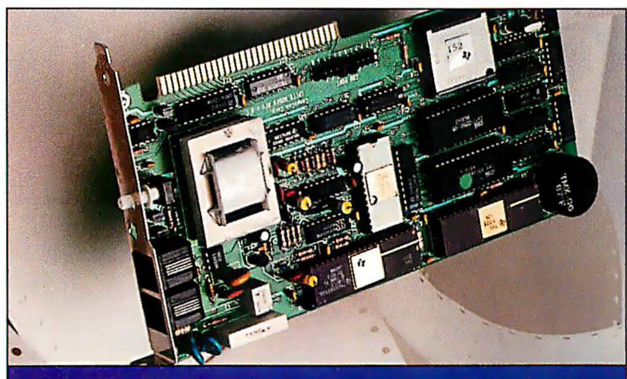
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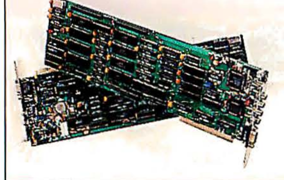
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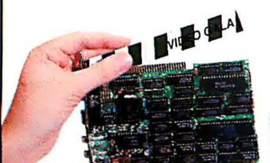
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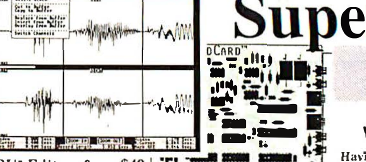
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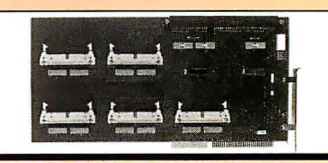
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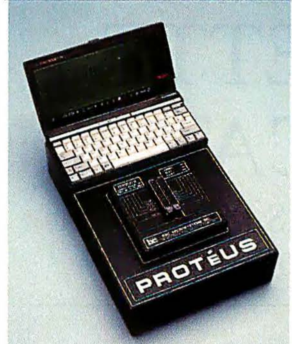


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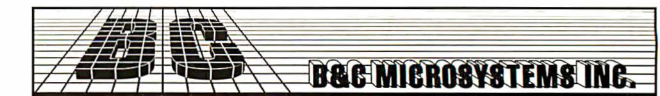
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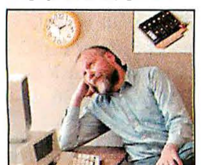
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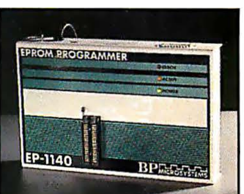
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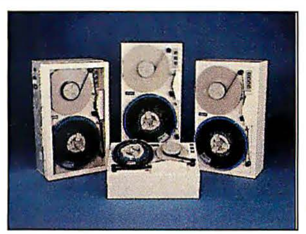
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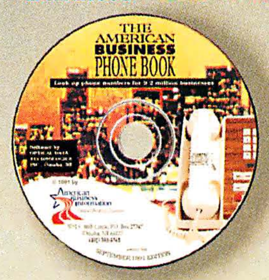
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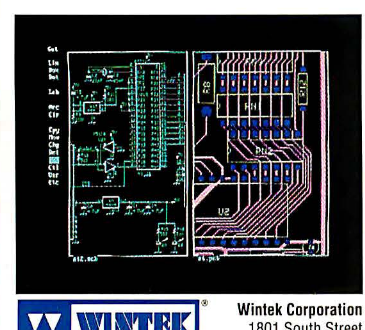
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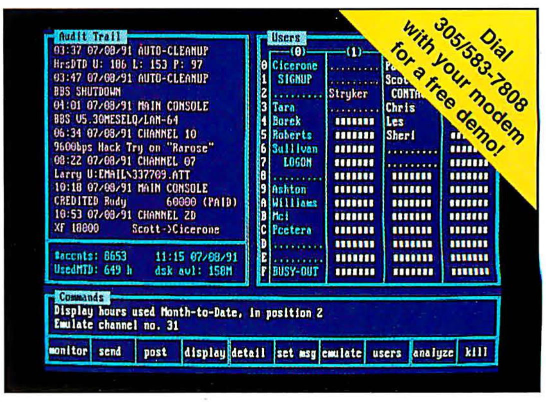
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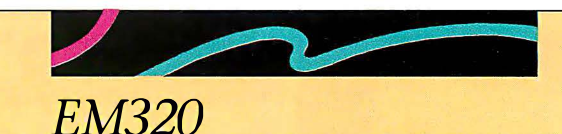
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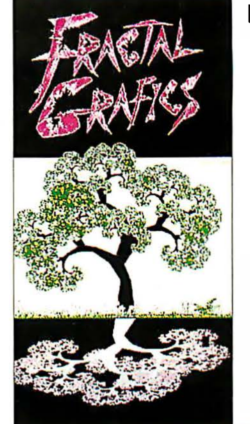
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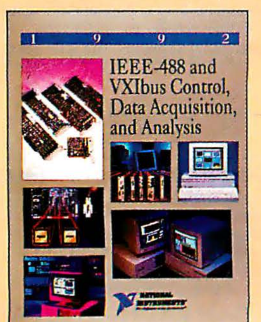
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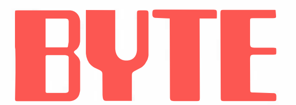


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NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS MAIL PERMIT NO. 176 PITTSFIELD, MA

POSTAGE WILL BE PAID BY ADDRESSEE



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PO Box 5110
Pittsfield, MA 01203-9926
USA





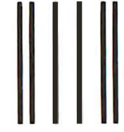
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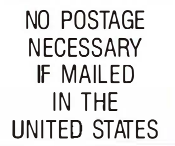
Mail Your Completed Card Today. For Quicker Response, Fax to 1-413-637-4343!

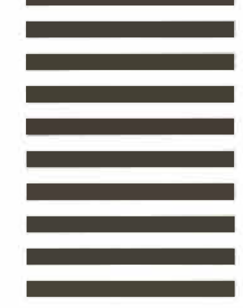
Circle the numbers on Inquiry Card which correspond to inquiry numbers assigned to items of interest to you.

Check all the appropriate answers to questions "A" through "E".

Print Your name and address and mail, or fax to 1-413-637-4343

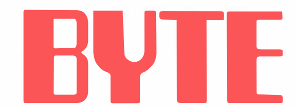






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FIRST CLASS MAIL PERMIT NO. 176 PITTSFIELD, MA

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Pittsfield, MA 01203-9926
USA

Fill out this coupon carefully. PLEASE PRINT.

NAME

TITLE

COMPANY

ADDRESS

CITY STATE ZIP

( ) PHONE ( ) FAX

A. What is your primary job function/principal area of responsibility? (Check one.)
1 ☐ MIS/DP
2 ☐ Programmer/Systems Analyst
3 ☐ Administration/Management
4 ☐ Sales/Marketing
5 ☐ Engineer/Scientist
6 ☐ Other

B. What is your level of management responsibility?
7 ☐ Senior-level
8 ☐ Middle-level
9 ☐ Professional

C. Are you a reseller (VAR, VAD, Dealer, Consultant)?
10 ☐ Yes
11 ☐ No

D. What operating systems are you currently using? (Check all that apply.)
12 ☐ PC/MS-DOS
13 ☐ DOS + Windows
14 ☐ OS/2
15 ☐ UNIX
16 ☐ MacOS
17 ☐ VAX/VMS

E. For how many people do you *influence* the purchase of hardware or software?
18 ☐ 1-25
19 ☐ 26-50
20 ☐ 51-99
21 ☐ 100 or more

☐ *Please send me one year of BYTE Magazine for $24.95 and bill me. Offer valid in U.S. and possessions only.*

JANUARY
IRSD01A

Inquiry Numbers 1-493

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EDITORIAL INDEX BY COMPANY

Index of companies covered in articles, columns, or news stories in this issue.
Each reference is to the first page of the article or section in which the company name appears.

Company, Page # Inquiry #

HUGH KENNER

Dead Chickens A-Wavin'

A celebration of hacker lingo; an indictment of its excesses

The stupidest way imaginable to sort a deck of cards? Try a floor-scatter, a random pickup, a check for order. No go? Just keep repeating. It'll work eventually. That's *bogo-sort*; according to Eric Raymond, "the archetypical perversely awful algorithm." So, "looking at a program and seeing a dumb algorithm, one might say 'Oh, I see, this program uses bogo-sort.' " And look, cross-references to *bogus* and *brute force*! Time for further page-turning in *The New Hacker's Dictionary*, which Raymond edited.

For in saying what a dumb program uses, you're invoking *bogosity* ("The degree to which something is bogus"). That's an element of *quantum bogodynamics*, "A theory that characterizes the universe in terms of bogon sources (politicians, used-car salesmen, TV evangelists and *suits* in general), bogon sinks (taxpayers, computers), and bogosity potential fields." But wait a minute, what is a "suit"? Why, either (1) the ugly, uncomfortable attire of a nonhacker, or (2) the kind of person who wears such, for instance an IBM salesperson. Suit (1) includes a "tie," which is "a strangulation device that partially cuts off the blood supply to the brain" and helps explain the behavior of any suit (2).

You'll have guessed that a *bogon* is "the elementary particle of bogosity," which helps locate bogo-sort in the bogo-field. You'll also have noted one absolute in this whirl of terms, namely, *hacker*. The great *Oxford English Dictionary* (2d ed., 1989) has it right: "A person with an enthusiasm for programming or using computers as an end in itself." (First citation, 1976: "The compulsive programmer, or hacker as he calls himself, is usually a superb technician.") Eric Raymond offers more detail; of his eight subdefinitions, the first is "A person who enjoys exploring the details of programmable systems and how to stretch their capabilities, as opposed to most users, who prefer to learn only the minimum necessary."

Having savored that half-page, you now grok *hacker* (grok—"To understand, usually in a global sense"). And the way to grok *The New Hacker's Dictionary* is to open it at random, read a definition, and then consult one of its boldfaced cross-references.... Continue; in four moves or fewer, you'll surely light on some wonder. My current favorite is "wave a dead chicken."

New to you? You've waved a dead chicken when you've gone through motions to satisfy onlookers (suits?), even when you're sure it's all futile.

Raymond's book exhilarates by displaying a community's jargon. Such jargon is alive; people enjoy it, extend it. By contrast, the dreary exhibits in John A. Barry's *Technobabble* display what happens when babblers without a clue set out to impress. An example: "...with peer-to-peer, client/server distributed computing environments rapidly replacing yesterday's hierarchical MIS-dominated mainframe/dumb terminal/isolated PC configurations..."; which is from a 1990 press kit, 50-some paper pages about the virtues of nonpaper documents.

Though Barry's book can get as repetitious as some of his examples, he does show a keen sense of what merits emphasis. Page-long lapses into the passive voice ("The function is implemented by activating the startup procedure."). Recourse to euphemism ("knowledge worker," meaning white-collar employee). Hedging ("supports the implementation of a windowing environment," which is deemed safer than "has a windows system," just in case some buyer can't get the windows to work). And confusion of user with product ("Once installed and configured, you're set."). And more; and more....

What we're seeing here is *absence* of community. Between salesperson and target there's nothing communal save a wary circling, as between panther and stag. The glorious creativity of the hackers derives from assurance of being understood, of having a coinage admired, accepted, used. (As the saying goes, "It fills a long-needed gap.") But *Technobabble* aims merely to impress, the way a mongoose impresses dazzled prey. Anyone who starts writing "supports the implementation of" (and, yes, such stuff is contagious) has undergone hypnosis, not enablement.

Barry's presence would be more salutary still if he'd more than a gut understanding of English usage. He misuses "dangling participle" throughout. "Climbing the mountain, the cabin came into view": There, "climbing" dangles, because the only noun it can hook to is "cabin," which wasn't what climbed. But "The interface is implemented by clicking the dialog box": That is not a dangler, just a passive-voice inelegance, since whoever implements also does the clicking. Likewise, "When you click the mouse a menu will appear on the screen" isn't (as Barry says) misused future tense but reliable habit.

Skim *Technobabble* for its horrible examples, its awful warnings. *The New Hacker's Dictionary*, though, is not for skimming. Allot, each day, a half hour, severely timed if you hope to get any work done. ■

The New Hacker's Dictionary, edited by Eric Raymond, MIT Press, 1991, $10.95 ($25 hardcover), 433 pp., ISBN 0-262-68069-6 (paper), ISBN 0-262-18145-2 (hardcover).
Technobabble, John A. Barry, MIT Press, 1991, $22.50, 268 pp., ISBN 0-262-02333-4.

Hugh Kenner is Franklin and Callaway Professor of English at the University of Georgia. He writes for publications ranging from the New York Times *to* Art & Antiques. *His recent books include* Mazes *and* Historical Fictions. *He can be contacted on BIX as "hkenner."*

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.



STOP BIT

ERIC S. RAYMOND

STANDARDS EVERYWHERE

Can you stand another standard? Look before you leap and save some effort.

Like everything else these days, the idea of a "standard" seems to get more complicated and perplexing by the month. Remember when a standard was something like a papal bull, handed down from on high by a synod of elderly engineers at an alphabet-soup institute somewhere? A few brave souls would read it; everybody else would pick it up by osmosis; IBM would ignore it or do something that was perversely incompatible; there'd be a bit of grumbling all around, and life would go on.

Ah, for those bygone days of decorous tranquility. They were doomed by the mid-1980s. Suddenly, everybody wanted his or her Fubar 1700 to get intimate with the Snafu Systems 23E in the next room, and standards became strategic weapons.

Nowadays, the term *standard* seems to have reverted to a more archaic sense—that of an insignia of battle or tribal totem. Corporations issue them, through paper-thin front groups or right out of their own PR offices. Feudal networks of lesser vendors form around the big guys, the battle is joined, and salvos of self-important press releases are exchanged. Eventually, everybody declares victory and goes home.

It's all very tiresome. Occasionally, one is refreshed by moments of genuine low comedy. Remember, for example, the year AT&T bungled its push for one big Unix standard by overplaying its hand? The subsequent formation of the Open Software Foundation and Unix International reminded me of the scene from Monty Python's *Life of Brian* in which two mobs of God-struck idiots hare off after different souvenirs of God. "Follow the shoe!" "No, no, the gourd! The sacred gourd!"

The people behind the corporate standards wars are all too aware of shortened product cycles and market pressure. No, instead you get lots and lots of standards; pick one, they're on special today. ACE versus SPARC versus EISA versus PS/2. X Window System versus News versus Display PostScript. And GUIs. Don't even *talk* to me about GUIs.

There's actual substance to at least some of these oppositions, and in my techie head, I'd happily sit for hours arguing the objective merits of one or the other. But the big clashes in the standards wars don't take place among techies anymore. The marketing of "openness" has redefined which standard to go with into a strategic decision. And techies don't make strategic decisions; they advise management types, who make decisions, knowing full well that most of the overpaid seat-fillers who pass as managers are really going to go with what their ulcers or their astrologers or their equally clueless golfing buddies have to say. Thus, the era of the corporate standard has actually reduced the relative influence of the few who have some real grasp of the issues. What's a poor user to do?

Herewith Raymond's Rules for Standards Survival:

1. Don't ever commit to a standard until you see at least three different conforming products from different vendors. This is elementary self-defense, and it helps you avoid getting suckered by the pie-in-the-sky-by-and-by school of corporate PR. Too many marketers have discovered that a smooth con job about a vaporous future standard can lock customers in as effectively as product purchases. Fight them.

2. Don't ever believe a standards announcement made solo by the market leader in any product category, especially if it happens to be IBM. "Standards" like these are just customer-control devices in disguise, and they will be quietly dead-lettered the moment they become inconvenient for the vendor. Of course, the sound of that standard expiring (taking your opportunity costs and maybe a heavy hardware, software, and training bill with them) will generally be drowned by the fanfare that announces an all-new, all-singing, all-dancing *improved* standard.

3. All other things being equal, the value of a standard is inversely proportional to the weight of its documentation. Simple, elegant standards aren't just technically pretty; they're healthy cost-savers for your engineering budget as well. A complex, tricky, exception-filled standard is automatically weighted toward the creators, because maintaining the cadre to learn and use it costs more. Be suspicious of any standard that your best techie can't grasp in a week; it's probably some competitor's fortress.

Follow these rules, and you won't get personally taken. Get your company to follow them, and *it* won't get taken. And when in doubt, hold off. Even if you miss *this* standard, another will be along directly. ■

Eric S. Raymond is an independent software designer and author of The New Hacker's Dictionary *(MIT Press, 1991). He can be reached on BIX c/o "editors."*

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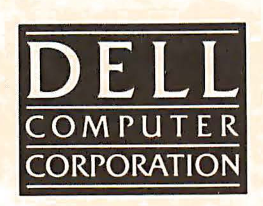
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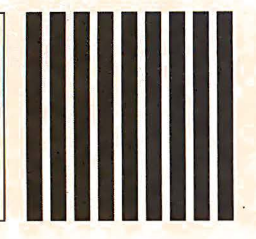
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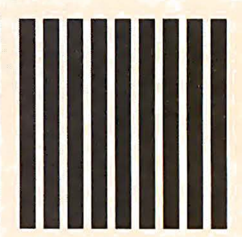




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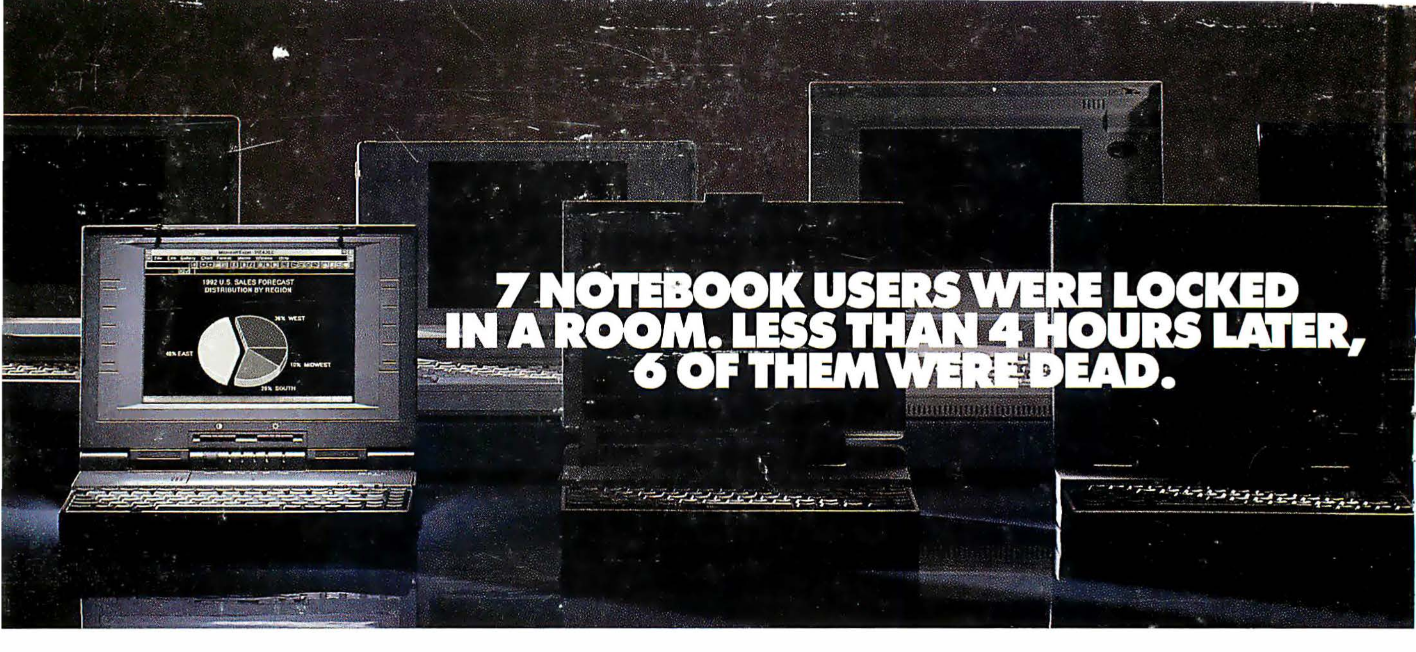
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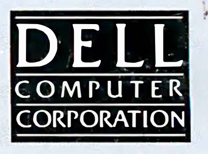


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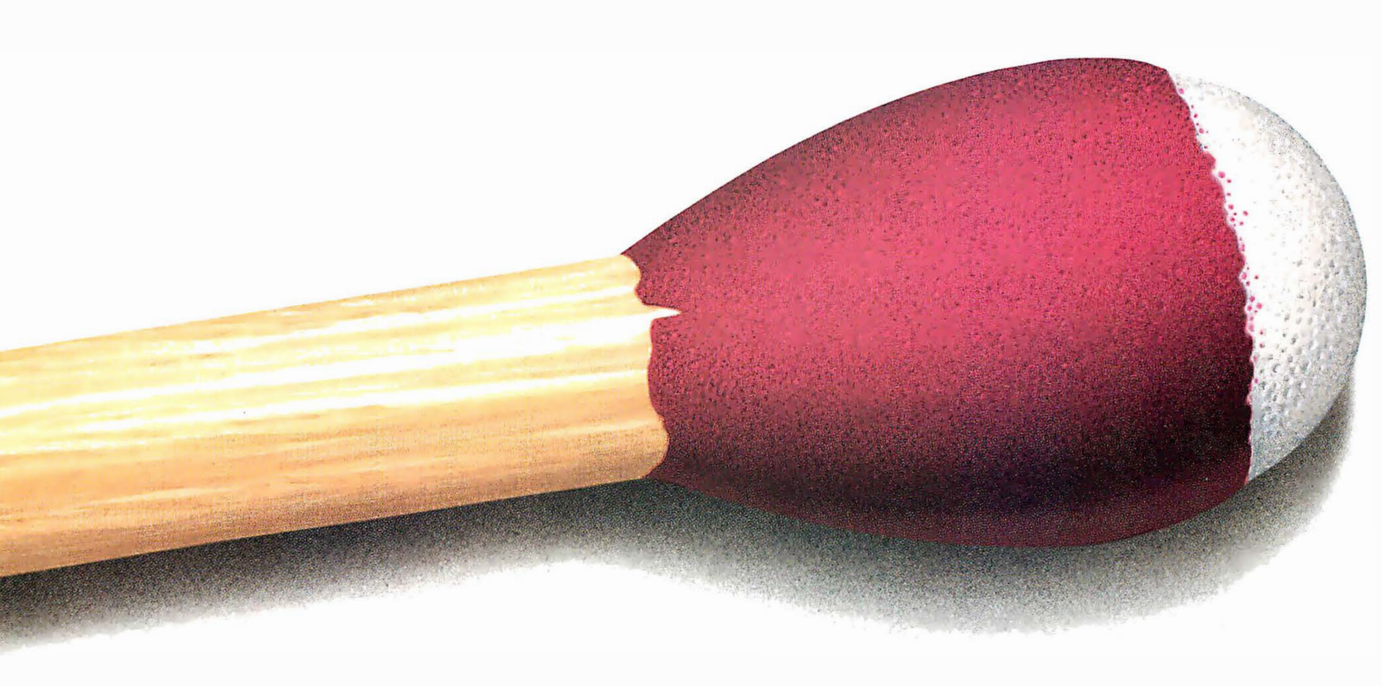
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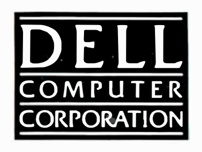
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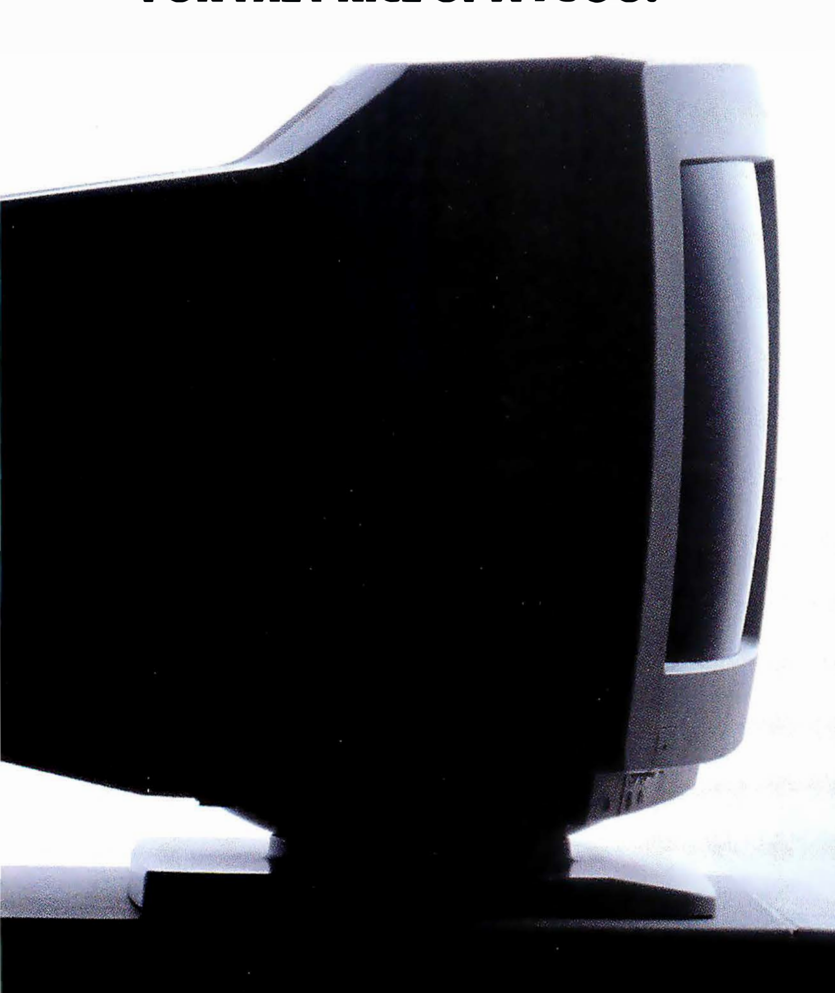
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